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The Spotted Tody-tyrant (*Todirostrum maculatum*) in Surinam. (*Top*) Fledgling. (*Bottom*) Nest (Entrance at left). Photographs by F. Haverschmidt.

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NOTES ON THE LIFE HISTORY OF *TODIROSTRUM MACULATUM* IN SURINAM

BY F. HAVERSCHMIDT

THE tody-tyrants (Family Tyrannidae, genus *Todirostrum*) are small, rather short-tailed birds, characterized by a peculiarly shaped bill, which resembles an elongated spatula. In the Spotted Tody-tyrant (*T. maculatum*), the crown is dark gray with white margins, the upperparts are olive-green, and the cheeks and throat are white with dark pear-shaped marks which extend over the yellow breast and abdomen. The sexes are indistinguishable. Specimens which I collected in Surinam weighed 7.3 and 7.6 grams (males), and 7.2 grams (female). The range of *T. maculatum* extends from northern Venezuela (Orinoco Delta), the Guianas, and the eastern slope of the Andes in Ecuador and Peru throughout the greater part of northern Brazil. Hellmayr (1927) recognizes two races, of which the nominate is found in Surinam.

In the coastal area of Surinam, two species of *Todirostrum* are of common occurrence. *T. cinereum*, the smaller of the two, is a common garden bird, which as a rule frequents rather dry ground. It is numerous on the sand reefs and in waste land, as well as in brushy savannas behind the coastal area. *T. maculatum*, on the other hand, is a bird of wet places. It is particularly numerous in the broad strip of mangroves (*Avicennia nitida*) bordering the coast, and it also frequents the bushes along creeks. There is, however, some overlapping in the habitats of the two species; I have sometimes found *T. cinereum* nesting in mangroves (December 15, 1953, and April 3, 1954). On the other hand, I have never found *T. maculatum* in the dry habitat where *T. cinereum* is common.

Feeding.—Tody-tyrants feed on insects and have a peculiar way of obtaining their food. From a sitting position on a branch, they suddenly jump to a leaf and, in flight, take an insect, with a distinct

snap of the mandibles. They also catch flying insects in the usual flycatcher fashion, as for instance, when they are feeding on flying termites.

Breeding season.—In my garden, where most of my notes were taken, I have found nests in all months of the year, but my material is still too meager to show seasonal peaks.

Nest.—The nest is a pouch with a roofed side entrance and hangs from a branch, usually at a height of from one to nine feet from the ground (Plate 15). It is somewhat larger than the similarly shaped nest of *T. cinereum* but lacks the long "tail" at the bottom, which is such a feature of nests of *T. cinereum*. (Compare with the pictures in Skutch, 1930.) It is built largely of dead plant material, but spider webs are used in considerable amounts. The lining consists of plant wool; I have never found any feathers in it.

Nest building.—The nest is built and lined by both sexes and can be completed in about a fortnight, although the period of construction is very variable. One nest, started on May 10, 1953, contained the first egg on May 24. I watched this nest for two hours on May 14; from 9:09 to 10:09, the birds brought nest material 51 times, from 10:09 to 11:09 A.M., only 29 times. By May 17, the tempo had lessened considerably; from 9:40 to 10:40, they arrived only 8 times with nesting material and from 10:40 to 11:40, 15 times. On this day they worked only on the lining of the nest. Each time after emerging from the nest they wiped their bills on a branch, often uttering their harsh call note *tee* or *tee tee* a few times.

Almost always, a new nest is built when the preceding one comes to grief, which is very often the case as we will see later. Material for the new nest is to a great extent taken from the old one; sometimes, it is even taken from other birds' nests. On April 2, 1953, I observed a pair busily taking material from a disused nest of a hummingbird (*Amazilia fimbriata*).

In two cases, old nests of earlier broods were repaired and used for a new brood. On September 18, 1952, a nest with two eggs which did not hatch was deserted. It again contained two eggs on October 14. In another nest, the first egg was laid on October 19, 1953. This nest was robbed on November 11; on December 20, it was repaired; and an egg was laid in it on December 31.

A very large percentage of nests is robbed of eggs and nestlings by predators. I suspect the Crested Oropendola (*Xanthornus decumanus*) of most of this predation. Some eggs and young may also be taken by Smooth-billed Anis (*Crotophaga ani*), which often inspect the row of *Lagerstroemia indica* trees in which the tody-tyrants make

most of their nests in my garden. On April 11, 1953, I surprised an oropendola inserting its bill into the entrance of a *Todirostrum* nest which was ready for eggs.

Between April, 1953, and January, 1954, the ten successive nests with eggs of a single pair of birds all met disaster. Although the birds were not marked, I am sure all ten nests belonged to the same pair as there was only a single pair in my garden and each new nest was made in the immediate neighborhood of the preceding one in the row of Lagerstroemias already mentioned. Most of these nests were within a few yards of each other, and in all cases, the material for the construction of a new nest was taken from the preceding one. The history of these nests follows:

Nest 1.—Nest started on April 2, 1953. (I was absent from April 16 to 20.) April 21 and 22, one egg; April 23, nest empty.

Nest 2.—April 24, nest started; May 3, still empty. (I was absent on May 4 and 5.) May 6, one egg; May 7, egg missing. Interval between destroying of nest 1 and laying of egg in nest 2, less than 13 days.

Nest 3.—May 10, new nest started; May 24, one egg (no more laid); June 8, egg gone. Interval between loss of egg in nest 2 and laying of egg in nest 3, 17 days.

Nest 4.—June 16, new nest found, apparently almost finished; June 23, first egg laid; July 5, nest robbed. Interval, 14 days.

Nest 5.—July 9, new nest being built; July 19, one egg (no more laid); nest robbed after a few days. Interval, 14 days.

Nest 6.—July 25, new nest under construction; August 4, two eggs; August 25, eggs taken. Exact interval not known.

Nest 7.—September 8, new nest being built; September 14, appeared ready for eggs; September 19, one egg; September 21, two eggs; October 6, nest robbed. Interval, 25 days, the longest of all.

Nest 8.—October 10, new nest under construction; October 19, one egg; October 21, two eggs; November 11, eggs missing. Interval, 13 days.

Nest 9.—November 19, new nest nearly finished; November 28, one egg; November 30, two eggs; December 13, nest robbed. Interval, 17 days.

Nest 10.—December 20, nest 8 is repaired; December 30, one egg; January 1, 1954, two eggs; January 26, eggs missing. Interval, 18 days.

The interval between the destroying of the eggs and the laying of the first egg in a new nest varied from 13 to 25 days. The birds did not make an eleventh attempt although they remained in my garden for some time.

Twice a nest was built beside a nest of wasps. A nest found on March 26, 1952, was near a nest of *Nectarina bilineolata* var. ***smithi*** Sauss. Nest 8 of the above list, which was later repaired and used again (as nest 10), was beside a nest of *Polybia occidentalis* var. ***parvula*** F. However, it is certainly not the rule for *T. maculatum* to build near wasps' nests as it is in the case of some birds in this region, for example, *Tolmomyias flaviventris* and *Pachyramphus polychopterus*.

Copulation.—I only observed copulation on November 18, 1952. The fledglings, which had left the nest on November 8, were still about when suddenly the male jumped on the back of the female. Shortly afterwards, the act was repeated once more.

Egg laying.—When the nest is (or appears) ready for eggs, it is left for a few days before the first egg is laid. This period is difficult to ascertain because without damaging the nest, it is impossible to determine whether or not its inner lining is finished. In all cases in which the full clutch consisted of two eggs, they were laid at two-day intervals: February 1 and 3, 1951; August 28 and 30, 1952; and October 19 and 21, 1953.

TABLE 1

ATTENTIVENESS DURING THE INCUBATION PERIOD

Date	*Period of observation*	*On nest*	*Off nest*	*Minutes on nest*	*Minutes off nest*
May 26, 1953[1]	13:44–14:44		13:44–13:48		
		13:48–14:08	14:08–14:24		
		14:24–14:44		40	20
June 4	15:03–16:03	15:03–15:50	15:50–16:03	47	13
June 5	13:15–14:15	13:15–13:52	13:52–14:15	37	23
June 6	10:13–11:13		10:13–10:38		
		10:38–10:55	10:55–11:13	23	37
June 7	9:37–10:37	9:37– 9:42	9:42–10:07		
		10:07–10:25	10:25–10:37	23	37
	16:00–17:00		16:00–16:08		
		16:08–16:56	16:56–17:00	48	12

[1] Third day of incubation.

Clutch size.—In most cases, the clutch consisted of two eggs, but in some of only a single one. Of eleven nests in which I was able to establish the full clutch, nine contained two eggs and two only one. The eggs are white with a few dark brown spots at the larger end. For measurements, I refer the reader to the material from the Penard Oölogical Collection (Hellebrekers, 1942). The weight of a fresh unblown egg which measured 16.3 × 11.3 mm. was 1.17 grams.

Incubation.—In one case (nest 3 of the list), I observed that one of the parent birds spent the night in the nest two days before the first egg was laid. On May 22 at 7 P.M. (it is dark by that time in this region), I observed, with the help of a flashlight, the bird sitting in its nest. The first egg was laid on May 24. Incubation starts after the laying of the second egg. Only one bird (probably the female) incubates, and I never saw any kind of nest relief. Table 1 gives some data on attentiveness at nest 3 during the incubation period. At this particular nest, I observed twice (on June 4 and 6)

that the bird returning to its nest after a period of inattentiveness was accompanied by its mate. Once the nonincubating bird even clung at the entrance while the other was inside. Owing to the fact that such a large number of nests was robbed before the eggs hatched, I could establish the incubation period in only two cases. In the first one, the first egg was laid on February 1 and the second on February 3. The first egg hatched on February 19 at about 6 P.M. and the second one on the early morning of February 20, which gives an incubation period of 17 days. In the second case the first egg was laid on December 30, the second on January 1. Both eggs hatched on February 18 which again is 17 days. Skutch (1945) gives the incubation period of *T. cinereum* in Panama as 17 and 18 days. In two cases, the eggs did not hatch and incubation was prolonged. In a nest where the second egg was laid on August 30, the eggs did not hatch and were deserted on September 18, after 19 days of incubation. In another nest, incubation on two eggs started on October 21, incubation was still in progress on November 10, after 20 days, and the nest was robbed on November 11.

TABLE 2

FREQUENCY OF FEEDING THE NESTLINGS

Date	*Age of nestlings*	*Period of observation*	*Times fed*
October 22, 1952	one day	10:20–11:20	4
October 23	2	10:05–11:05	5
		11:30–12:30	5
October 25	4	10:20–11:20	10
		11:20–12:20	6
October 26	5	15:00–16:00	5
October 27	6	10:55–11:55	7
		11:55–12:55	7
October 28	7	10:57–11:57	12
October 29	8	9:50–10:50	11
November 1	11	11:15–12:15	5
November 2	12	14:30–15:30	11
		16:00–17:00	14
November 3	13	10:40–11:40	12
November 5	15	10:10–11:10	13
November 6	16	11:15–12:15	13

Rearing of the young.—The nestlings are fed by both parents. Table 2 gives data on the frequency of feeding at a nest with two young which hatched on October 21 and 22, 1952.

The young were hardly brooded at all. On October 22, one of the parents stayed with the young for only about three minutes. Usually the parents did not enter the nest with food but clung to the entrance

and fed the young from outside. The feces of the nestlings were swallowed by both parents. Other birds such as *Camptostoma obsoletum* and *Tolmomyias flaviventris* venturing in the neighborhood of the nest, were chased away and even pursued for rather long distances.

I was able to establish the fledging period in only two cases. From a clutch with two eggs which hatched on April 11, 1952, the single surviving young left the nest on April 28, a period of 17 days. In the second case, the eggs hatched on October 21 and 22, 1952, and the two young left the nest on November 8, fledging periods of 17 and 18 days. At that time, the young were able to fly well.

The nestlings were fed small insects, only one at a time being taken to them. Three times I noted that the food was small butterflies. As already mentioned, very few broods are undisturbed; of 14 nests containing full clutches, young were fledged from only two: two young from one nest and one from the other. Skutch (1930) also mentions a tremendous loss of nests of *T. cinereum* in Panama.

Bathing.—I frequently observed *T. maculatum* bathing. Most often this was the usual showerbath in the rain, in which the bird sits in an open situation during a heavy shower and lets the raindrops fall over it, making shivering movements with its wings and preening all the time. On June 11, 1949, I watched a different kind, resembling the normal way of feeding. The bird was sitting in a Frangipani (*Plumeria rubra*), its big leaves drenched after a heavy shower. Suddenly the bird jumped against a leaf so that a little shower of drops fell over it. Then it shivered its wings and started preening. This was repeated several times. I am certain that in this case it was not feeding but bathing.

SUMMARY

Todirostrum maculatum is a common bird in the coastal area of Surinam, frequenting wet places, especially the mangroves along the coast and creeks.

Nests with eggs may be found in all months of the year. The nest is a pouch with a roofed side entrance and hangs from a branch. It is built by both sexes. Nest building lasts about a fortnight. Nests are sometimes constructed near wasps' nests, though this is not the rule.

The clutch consists of two eggs, laid two days apart, or only a single egg. Only one bird (probably the female) incubates. In two cases, incubation lasted 17 days. The nestlings are fed by both parents. Data on the feeding frequency are given. In two

cases, the fledging period lasted 17 and 17–18 days. A great many nests are robbed. Particulars are given of ten successive unsuccessful nests of a single pair during the period April to January.

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P. O. Box 644, Paramaribo, Surinam, June 2, 1954.

IN MEMORIAM: ARTHUR CLEVELAND BENT

BY WENDELL TABER

ARTHUR CLEVELAND BENT, President of the American Ornithologists' Union from 1935 to 1937, died in his home on December 30, 1954. Born on November 25, 1866, the son of William Henry Bent and Harriet Fellowes Hendee Bent, he had lived for many years at 140 High Street in Taunton, Massachusetts, diagonally across the street from the home of his childhood days. Bishop Cleveland, for whom he was named, was a favorite friend of the family.

His mother died when he was about six years old. Not many years later his father, watching a frail and delicate child growing up, embarked him on an invigorating outdoor life to promote physical development. Father and son would amble off together on long walks into the woods and country so easily accessible around Taunton in those days. Came the bicycle at first, that one-huge-wheel affair with trailer-wheel, and carriage drives to exercise the family horse. Not until many years later, when he was in middle life, did the era of the automobile arrive. Much of the time he was alone, simply because of inability to arouse interest among his companions. With the limited transportation facilities of the era, bird trips were necessarily of a type that would now be considered local. Rarely did they extend beyond the neighboring townships of Rehobeth and Fall River. Ultimately, he became acquainted with and frequently joined forces with Owen Durfee of Fall River, only a few years his senior. In these boyhood days, too, came the beginnings of specimen and egg collections. Carried on throughout years of travel all over North America, the specimen collection ultimately attained a size which warranted presentation to Harvard University. Similarly, the U. S. National Museum in Washington received a 30,000-unit egg collection. The trips were health-maintaining, and ornithologically constructive. At home, the use of an axe later in life was a daily delight. At night came setting-up exercises with dumbbells. His major long-distance trips ceased when he was 60: the axe and dumbbells he kept using until he was over 80.

Primary education in the local public schools instilled in him a lasting spirit of democracy. After seven years of secondary education at Bristol Academy, he entered Harvard College. He graduated, with Honorable Mention, and an A.B. degree, in 1889. A broken nose from boxing reflected his athletic career.

In the fall of 1889, he commenced work with the Massachusetts National Bank at a salary of $15 a month. Early in 1890, however,

ARTHUR CLEVELAND BENT

he went to Fall River to learn the cotton mill business, working in the Crescent Mills. In the fall of 1891, he took charge of the Seamless Pocket Mill in Plymouth, a position he retained for four years, drawing a monthly salary of $50. He was able to augment his income by acting, also, as manager of the Atlantic Covering Co., which manufactured magnet wire. Here he obtained a yearly salary of $1000. He invested $1000 in the business—and lost it when the company failed in the Panic of 1893. In the fall of 1892, he and a certain John Scott purchased the Plymouth Electric Light Co. from the General Electric Co. for $87,500—in notes with company bonds as collateral. He writes, "In the Panic of 1893 the Electric Light Company defaulted on its bonds and was bankrupt and so was I, as I could not meet my notes. John Scott died bankrupt and I had to buy out his interest in the company and assume his debt. But I persuaded the General Electric Company to let me work out the situation, which I finally did." One sees, here, the beginning of the successful business man, inspiring confidence and trust, overcoming tremendous obstacles, forging ahead. In his sixties, "After the sale of Plymouth interests, (I) retired from all business, to live on income from what was left, and devote my time to ornithology."

On October 23, 1895, he married Rosalba Peale Smith, daughter of Professor Clement L. Smith, a former Dean of Harvard College. After a few months the Bents moved from Plymouth to Taunton and Bent became associated with the Mason Machine Works as superintendent's assistant. Ultimately he became General Manager, a position held before him by his father and brother. He moved the Seamless Pocket Co. to Lowell in connection with the Whittier Cotton Mills there, and was able to reduce his time with that company to one day a week. Childless, the couple was divorced in 1911.

In 1914, he married Madeleine Vincent Godfrey, who survives as do three married daughters, six grandchildren, two great granddaughters and a great grandson. The family is noted in Taunton for its almost Scottish clannishness and unity. On Thanksgiving Day in 1954 the assembled family, 18 of them, took turns going upstairs to see the patriarch.

One can but be awe-struck by the dynamic energy and vitality displayed by this former "frail youth." In his initial three jobs, he worked from 6:30 A.M. to 10:00 P.M. daily. Success came from all directions—business, civic affairs, charities, ornithology. He was President and Treasurer of the Plymouth Electric Light Co. from 1900 to 1931, and General Manager of the Mason Machine Works from 1900 to 1914. He also served as Treasurer and Director

of this company. At one time or another he acted as Vice President and Manager of the Campbell Printing Press and Manufacturing Co., N. Y., Vice President of the Autoplate Co. of America, Director of the Jager Engine Co., and Director of the Corr Manufacturing Co. He preferred that limited success which he could derive operating from his own home city to the greater glitter of a business career in a large metropolis. Envisioning the future of the then infant public utility field, he organized and developed a number of small, local utilities. He was President of the Provincetown Light and Power Co., President of the Old Colony Light and Power Association, Director of the Plymouth Gas Co., Southeastern Mass. Power and Electric Co., and Trustee of the Massachusetts Utilities Associates.

Civic duties he took seriously, entering whole-heartedly into the life of his community. He was an Alderman of Taunton in 1906 and one of the nine members of the first Municipal Council set up in 1910 under the new city charter. He also held a three-year term on the School Committee. During the First World War this prominent business executive and municipal leader, a corporal in the State Guard, drilled in the armory, on rifle range, on parade, under regular army discipline, and did a tour of duty in camp each summer. He also acted as escort for the Governor on the latter's public appearances. He still found time to become farm agent for the Food Administration Board, urging Bristol County farmers to produce more food, and he worked closely with the Exemption Board to secure exemption from military service for those farmers who were producing satisfactorily. He was a member of the local committee on public safety, and a "Four Minute Speaker." He organized and served as President of the Bristol County Academy of Sciences, acted as President of the Taunton Chamber of Commerce and a Trustee of the Taunton Savings Bank. Many were the other committees of which he was chairman or a member, undertaking to raise funds for various civic purposes.

Along charitable lines he was Vice President of the Associated Charities of Taunton. Came the depression of the 1930s and he acted as chairman of the so-called "Rochester Plan" which raised over $300,000 in promised employment for improvements. He took special interest in youth and for his services as Scout Commissioner for Anawan Council, Boy Scouts of America, he received the Silver Beaver with citation. He also took an interest in the John Burroughs Association in New York and was a recipient of the John Burroughs Medal. He served as President of the Massachusetts Society for the Prevention of Cruelty to Children, and of the Social Welfare League.

Devoutly religious, he took an active part throughout his adult life as vestryman, clerk, or senior warden of the St. Thomas Episcopal Church in Taunton.

Indicative of the extraordinary breadth of mind and character of the man was his club membership. He organized, became president of, and moved a few times, the Segregansett Country Club as it is now called. He was a member of organizations such as the Taunton Yacht Club, the Taunton Rod and Gun Club, the Bristol Branting Club—and in sharp contrast, organizations such as the Massachusetts Audubon Society where his name appeared in the lengthy list of Honorary Vice Presidents, the Massachusetts Fish and Game Protective Association, the Massachusetts Forestry Association, the American Forestry Association, and the National Association of Audubon Societies. Other clubs included the Old Colony Club in Plymouth, the Harvard Clubs in Taunton, Fall River, and Boston, the University Club in Boston, the Cosmos Club in Washington, and the Explorers Club (Honorary) in New York.

In spite of the pressure of business, civic, and charitable interests, he somehow found time, too, to keep up an interest in birds and to publish numerous minor ornithological papers. Until about 25 years ago the Bents maintained a summer home in Harwich on Cape Cod. Thence it was but a short motor trip to Chatham and Monomoy. The latter area was a favorite haunt. In later life he looked forward annually to a day's outing counting osprey nests in the late spring in southeastern Rhode Island and adjoining parts of Massachusetts. Many were the different ornithologists who partook in this memorable event. Not infrequently the group would record, also, the Carolina Wren and the White-eyed Vireo.

The childhood joys of exploring the great unknown found reflection in the adult on a grand scale. And this in spite of an episode which might well have caused a less confident, strong-willed man to relax into a life of comparative ease! Right at the peak of his young manhood, in 1896, alone, he shinned without climbers up the trunk of a large dead oak in a tract of swampy, mixed woods in North Middleboro, near Taunton. While attempting to reach into a wide, deep cavity for the eggs of a Barred Owl, he slipped and fell. He jerked to a stop with his arm tightly wedged in the narrow slit at the lower end of the opening. For 25 minutes by the village clock, visible in the distance (he would take note of that) he struggled hopelessly, calling in vain for help. How, he never knew: he tore his arm loose. The fall should have killed him. On the ground, he rested for some time in a state of collapse and exhaustion. For the rest of his life

he carried the reminder—a trembling hand. With the passage of time the other hand developed a sympathetic reaction.

The great unknown called him. Without premeditation, he prepared himself by travel and exploration for greater things to come. Later, as part of his self-preparation for writing life histories, he methodically set about the task of seeing North America. The chronology of his trips is:

1901. North Dakota with H. K. Job and C. G. Day
1902. Florida, east coast, with Job and Day
1903. Florida Keys, with Job and Day
1904. Magdalen Islands and Nova Scotia with Job, M. L. Church, and an eager youth named James Lee Peters
1905. Assiniboia, Saskatchewan, with Job and Day; L. B. Bishop joined them later
1906. Saskatchewan, with Bishop; later, Jonathan Dwight joined them
1907. Cobbs Island, Virginia, and Nova Scotia, both with Bishop
1908. Florida Keys with F. M. Chapman and L. A. Fuertes
1909. Labrador, southern, with C. W. Townsend
1910. Louisiana coast
1911. Aleutian Islands and Alaskan points with A. Wetmore, R. H. Beck, and F. B. McKechrue
1912. Newfoundland and eastern Labrador with D. B. MacMillan
1913. Manitoba with Job and F. S. Hersey
1914. California and the Canadian Rockies with Madeleine V. Bent
1915. South Carolina with his family and A. T. Wayne; also alone to the Magdalen Islands
1916. Virginia with H. H. Bailey
1917. Northern Saskatchewan alone
1918–19. Remained at home on war work
1920. Percé, Province of Quebec, with family
1922. Arizona with F. C. Willard
1923. Texas with G. F. Simmons and others
1924–25. Central Florida with family
1926. Central Florida with family
1929. California with family
1930. Southern Florida with family

Here, again, the family man is in evidence. Mrs. Bent quite unconsciously summarizes much in writing, "Time was such a precious commodity to him, and although he gave much of himself to his family and friends, most of his days were spent in accomplishment in many walks of life."

On November 18, 1888, just before his 22nd birthday, a senior at Harvard, he was elected a member of the Nuttall Ornithological Club. Under the then by-laws of the club his membership automatically ceased when he left Cambridge upon graduation. Of this brief initial membership, however, C. F. Batchelder wrote in "An Account of the Nuttall Ornithological Club, 1873 to 1919," that "even in that short time he had taken such a place that he was not to be forgotten." To the end of his life it was a bitter blow that, as one of the oldest members of the club in 1938, yet still physically active, there could be no 50th Anniversary Celebration at Mr. Batchelder's home. Actually, Bent had been re-elected, under revised by-laws, in 1896, and he had served on the Council from December 1, 1902, to December 7, 1914. Some compensation for this unfortunate situation did occur when, on October 15, 1945, he was elected to Honorary Membership. To the best of my knowledge such rank has otherwise been held only by Henry Wetherbee Henshaw, John Hall Sage, and Witmer Stone, all of whom were elected on the occasion of the Club's 50th Anniversary celebration on December 7, 1923.

In 1893, Bent became a member of the Wilson Ornithological Club. Not until 1909 did he become an Associate of the American Ornithologists' Union, but by 1920 he was a Fellow. He became a Vice President in 1929 and was elevated to the presidency in 1935. In 1909 he also joined the Cooper Ornithological Club. He was elected an Honorary Member of this organization in 1933. Other associations included the old Boston Society of Natural History, the Linnaean Society (Honorary), the Philadelphia Academy of Natural Sciences, the California Academy of Sciences, and the Maine Audubon Society. He was a recipient of the William Brewster Award from the American Ornithologists' Union, and the Daniel Giraud Elliot Medal from the National Academy of Science. At Harvard University, he was Associate in Ornithology attached to the Museum of Comparative Zoology. In Washington, he held the Asher Chair of Biology at the Smithsonian Institution and the title of Collaborator, U. S. National Museum. Modestly, he writes, "In considering the amount of ornithological work that I have done, allowance must be made for the fact that I was deeply engaged in various business enterprises until I was 48 years old, and only partially retired then. I did not wholly retire from business until I was over 60. Most of my ornithological exploration was done between the ages of 35 and 60. I have not travelled far from home since I was 65."

Not until 1910 did he undertake to carry on the work left unfinished by Major Charles Bendire. In that year, under the instigation and encouragement, especially, of Charles Foster Batchelder, who con-

tinued a life-long admirer, he engaged with the Smithsonian Institution to write "6 large volumes" of "Life Histories of North American Birds," as he calculated in 1914. Another forecast, "It will be my life work," proved far more accurate. Characteristically, he elected to lay out a framework uniformly applicable throughout the entire check-list and to start anew from the very beginning. He gathered material himself. He engaged the cooperation of ornithologists throughout the Western Hemisphere—and ultimately even abroad—originally as contributors of information, later as collaborating authors. His vision stood the test of time and expanding knowledge. Minor changes or additions sufficed to maintain the standards at modern levels. The censensus of many qualified ornithologists today is that the series should be completed in its original style.

The Smithsonian Institution has published 19 volumes of "Life Histories of North American Birds" by Arthur Cleveland Bent. These carry through the North American Wood Warblers. The twentieth volume, on the Icteridae and Thraupidae, has long been in Washington awaiting publication. Except for a few papers in process of preparation by collaborating authors, a twenty-first volume, as planned by him and extending through the Green-tailed Towhee, *Chlorura chlorura*, is in manuscript.

Rare, indeed, is the person so showered with success in whatever he touched who, though exhibiting justifiable pride and pleasure at times, could in the same moment display that modesty so distinctive in and dominative of his entire life. What better manifestation than his comments in the first of the Life History volumes—"No one is so well aware of the many shortcomings and omissions as the author. Allowance must be made for the magnitude of the undertaking."

His work commenced in 1910. The first volume was published in 1919. With the publication of the volume on Wood Warblers in 1953 the business man, impatient for action, but long accustomed by that time to protracted delays between completion of manuscript and appearance in print, took the offense as the best defense. Smarting a bit, perhaps, from criticisms of having omitted important recently published papers from his compilations (an unfair criticism), he remarks in the Introduction, "The manuscript for this Bulletin was written in 1945; only important information could be added. If the reader fails to find in these pages anything that he knows about birds, he can only blame himself for failing to send the information to—The Author."

The long delays in publication might well have caused a weaker

personality to give up. Bent went doggedly on. The work necessarily made him almost a hermit during working hours—yet this was not such in fact. The vital correspondence served as a substitute, keeping his brain in active contact with other brains. The sedentary nature of his work, commenced so late in life, coupled with his enthusiasm, may well have been a major factor in his longevity.

Seldom does it fall to the lot of man to have evidenced in his old age the esteem not only of his contemporaries—those that remain—but of younger generations in addition. On his eightieth birthday, November 25, 1946, after his customary spell with his axe, he went to attend in Boston a birthday dinner given under the auspices of the Nuttall Ornithological Club. From far and wide assembled 112 men. James Lee Peters, President of the Club, presided. Also at the head table was Hoyes Lloyd, at that time President of the American Ornithologists' Union. Other Fellows present were James P. Chapin, L. Griscom, A. O. Gross, F. C. Lincoln, H. C. Oberholser, and A. Wetmore. Charles Foster Batchelder, Bent's senior by over ten years, was able to attend in spirit, only. Jim Peters, commenting on the presence of 9 Fellows and 7 Members, remarked he had never seen so much North American ornithological talent assembled at once outside of an "A.O.U. Meeting." Of the other persons present, 5 have since been elected Members.

Meeting for the first time this man in his middle eighties, one might well have been startled to see him suddenly galvanize and become the alert, tense young business executive, sparkling with power and confidence as he responded in emergency with a flashing, concluding major decision. Incredible? No! Underneath, never dormant, was that driving force and first-hand knowledge of humanity which had taken him to the top in the business world. One saw only the decision. Long in advance he had been thinking, thinking, laying plans against what his calm, analytical judgment told him *could* happen. The crisis came! He was ready!

3 Mercer Circle, Cambridge 38, Massachusetts, May 30, 1955.

ON THE HEARING OF BIRDS

BY JOHANN SCHWARTZKOPFF

COMMON sense suggests that birds can hear tones of the same range as those which they produce. However, precise investigations have revealed exceptions and limitations to this rule. All birds, for instance, can hear frequencies down to a minimum of about 50 cycles (table 1); but even the voice of the Great Horned Owl (*Bubo virginianus*) is considerably higher than this. The upper limit of hearing is usually reached at 20,000 cycles (reached after conditioning), but cochlear potentials have been detected at 25,000 to 30,000 cycles by using greater intensities of sound than those normally encountered by the ear. The notes of song birds, however, frequently contain still higher harmonics (Brand, 1938).

The highest sensitivity of hearing in a given species—which in song birds reaches the human threshold (Schwartzkopff, 1949) and in owls probably exceeds it—is mostly found at the modal center of the voice of that species. Among related species, the larger ones have lower voices, and hearing sensitivity shows a corresponding trend (compare *Corvus* and *Pica* with *Pyrrhula* and *Fringilla* in table 1). Such a shift is undoubtedly owing to differences in the dimensions of the vibrating parts (specific resonance). Exceptions to this size-voice relation are of ecological and physiological interest. For example, owls are very sensitive to tones above the midpoint of the voice of song birds (6000 cycles), but which correspond to the squeak of some mice. Baby chicks hear almost nothing but the low clucking of their mother (400 cycles) while the hen reacts with preference to the very high cheeping (above 3000 cycles) of her offspring (Collias and Joos, 1953).

Though one cannot always with certainty apply to physiology conclusions drawn from ethology, it seems that in the present case something having to do with the developmental stage of the middle ear of chicks impedes the reception of higher notes (table 2). There is probably a selective value in the chicks being able to hear only the mother and not their fellow chicks.

The mechanism of sound transmission by the middle ear has not yet been analyzed in detail. Its function might be even more important for birds than it is for man, for birds' ears are almost inaccessible to bone-conducted sound (Denker, 1907), being largely surrounded by air spaces. Removal of the middle ear reduces the sensitivity of hearing to 1/75 or 1/100 of the original value, even for high notes (Schwartzkopff, 1949, 1952). The influence of the middle ear on

the general and spectral sensitivity is known from human physiology (Pumphrey, 1948). If the outer ear opening and the drum are large, much sound energy can reach the middle ear. It depends then on the motility of the drum membrane whether this energy is uselessly reflected or is taken up by the middle ear and transferred to the inner ear. This mechanism, the so-called acoustical adaptation, is determined by several factors, such as the elastic properties of the ear drum, its damping by the air cushions of the middle ear cavity and communicating spaces, and by the resistance of the inner ear to sound vibrations.

TABLE 1

THE HEARING RANGE OF MAN AND SEVERAL BIRDS

Species	*Lower limit cs./sec.*	*Highest sensitivity cs./sec.*	*Upper limit cs./sec.*	*Method*	*Author*
Homo sapiens	16	1000–3000	20,000	—	—
Melopsittacus undulatus	40	—	14,000	D	Knecht, 1940
Sturnus vulgaris	<100	2000	15,000	D	Granit, 1941
Loxia curvirostra	—	—	20,000	D	Knecht, 1940
Passer domesticus	—	—	18,000	D	Granit, 1941
Erithacus rubecula	—	—	21,000	D	Granit, 1941
Chloris chloris	—	—	20,000	D	Granit, 1941
Pyrrhula pyrrhula	—	—	21,000	D	Granit, 1941
	<100	3200	—	D	Schwartzkopff, 1949
	<200	3200	20,000–25,000	C	Schwartzkopff, 1952
Fringilla coelebs	<200	3200	29,000	C	Schwartzkopff, 1955
Pica pica	<100	800–1600	21,000	C	Schwartzkopff, 1955
Corvus sp.	<300	1000–2000	< 8,000	D	Trainer, 1946
Falco sparverius	<300	2000	<10,000	D	Trainer, 1946
Anas platyrhynchos	<300	2000–3000	< 8,000	D	Trainer, 1946
Columba livia	<300	1000–2000	—	D	Trainer, 1946
	—	—	12,000	D	Wassiljew, 1933
	50	1800–2400	11,500	C	Wever and Bray, 1936
Asio otus	<100	6000	18,000	D	Schwartzkopff, 1955
Strix aluco	<100	3000–6000	21,000	C	Schwartzkopff, 1955
Bubo virginianus	60	1000	< 8,000	D	Trainer, 1946

D = conditioning. C = cochlear potentials.

It has been known for a long time that the air chambers of the skull are exceedingly well developed in birds which hear well. The two middle ear cavities of all birds communicate by way of these chambers. However, the communication between these cavities has no influence upon hearing proper, for only slow changes of air pressure can spread from one ear to the other (Wada, 1923; Schwartzkopff, 1952). It is conceivable that this mechanism, working like a differential pressure gage, provides the flying bird a means of perceiving air streams.

The transfer of the acoustical vibration from the ear drum to the inner ear is provided by means of a force transformation: vibrations of large amplitude are converted into vibrations of small amplitude

TABLE 2

AREA RELATIONS OF THE DRUM MEMBRANE, THE COLUMELLA FOOTPLATE, AND BODY IN SEVERAL BIRDS

Species	*Body area (weight ⅔) "cm²"*	*Relative drum size (drum area) / (body area)*	*Area transformation of middle ear (drum area) / (footplate area)*
*Phylloscopus trochilus**	4.5	0.021	28
Parus caeruleus	5.1	0.016	26
*Hippolais icterina**	5.7	0.015	29
*Sylvia atricapilla**	6.6	0.019	29
Hirundo rustica	7.4	0.010	19
*Fringilla coelebs**	7.9	0.015	28
Pyrrhula pyrrhula	9.0	0.013	24
Passer domesticus	9.6	0.0094	22
Turdus merula	20.9	0.0077	22
Pica pica	35.5	0.0075	23
Corvus corone	65.5	0.0053	23
Asio otus	44.9	0.0107	40
Strix aluco	66.4	0.0089	30
Columba livia (domestic)	47.8	0.0043	14
Buteo buteo	86.1	0.0039	18
Podiceps cristatus	86.0	0.0016	16
Phasianus colchicus	113.0	0.0033	28
Gallus gallus (domestic)			
adult	153.0	0.0019	22
40 days old	27.6	0.0052	17
1 day old	10.5	0.0066	11

* Outstanding songsters, producing very high notes.

but great force at the oval window. The elasticity of the drum membrane and the adjacent processus of the ear ossicle, the extracolumella, gives the apparatus low sonic resistance. Because the area of the drum is large and that of the columella footplate in the oval window is small, the force is amplified. A study of the dimensions of these two areas and their relation to body size shows that small birds generally have relatively large drum membranes. If this were not true, their auditory sensitivity would be poor. The owls again do not fit into this series (table 2). Their unusually large drum indicates the exceptional acuity of their ear. The relative sizes of the drum and the columella footplate are correlated with the manner of life. Efficient songsters in whom one may expect an auditory apparatus working with as little distortion as possible are distinguished by a high transformation quotient, yet even they are surpassed by the owls.

Owing to their nocturnal mode of life, owls depend on the ear to an exceptional degree, and they show still further specializations. The round window is about five times greater than the oval one. The motility of the auditory ossicle is further improved. Moreover

by this arrangement, the columella not only describes piston-like motions, as it does in species which hear less well (Pohlman, 1921), but it also acts as a lever. Since the movements of this lever produce considerable turning moments at the remarkable velocity of the sonic vibrations, the pressure upon the hinge, namely the elastic connection with the footplate in the oval window (annulus fibrosus), must be reduced. This is done through "mass equilibration": the inner surface of the footplate is prolonged into a tip which projects

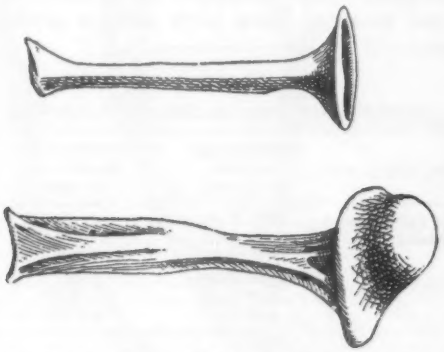

FIGURE 1. The auditory ossicles of *Uria aalge* (top) and *Strix aluco;* the latter species possesses outstanding hearing abilities. Notice the prolongation of the internal surface of the footplate in the owl. From Krause (1901).

into the perilymph of the inner ear; and the tip has a special shape which prevents the formation of eddies (figure 1). Finally, the inner ear of owls is much longer than one would expect from body size (Schwartzkopff, 1955). This suggests that owls may possess an unusual ability to analyze sound, though this has not yet been investigated physiologically.

Likewise, the assumption remains unproved that the great asymmetry of the ears of many owls causes differences in the spectral properties of the received sound and this facilitates locating its origin (Freye, 1953; Pumphrey, 1948). Undoubtedly the owls are able—as has been studied more exactly in song birds (Schwartzkopff, 1952)—to make use of the differences in intensity between the ears. In this, the opercular flaps are of great importance. But also the time difference between the arrival of the sound signal at the two ears assists these birds in locating their prey. Owls reach at least the human difference threshold (3×10^{-5} sec.). The heads of song birds are too small to permit drawing advantage from such a time difference (Schwartzkopff, 1952).

It seems that information on pitch discrimination is available only from song birds, parrots, and pigeons. While the first two groups reach human abilities, the performance of pigeons remains below even that of some fishes (table 3). Ecological considerations render the comparative values for these birds reliable, for the voices of song birds and parrots have much wider ranges of pitch than those of pigeons. The finding that birds, experimentally rendered deaf, sing rather well, even years after the operation, cannot be considered as a decisive argument against the correlation between song development and hearing. How birds achieve pitch discrimination is still a mystery.

TABLE 3

SOUND DISCRIMINATION IN MAN, BIRDS, AND FISH

Species	*Optimal range in cycles per second*	*Discrimination threshold in per cent*	*Author*
Home sapiens	1000–3000	0.3	Ranke, 1953
Melopsittacus undulatus	1000–3000	0.3–0.7	Knecht, 1940
Loxia curvirostra	1000–3000	0.3–0.7	Knecht, 1940
Columba livia	1000–2000	6	Wassiljew, 1933
Phoxinus laevis	400–1000	3	Dijkgraaf, 1952
Sargus annularis	150–450	<9–15	Dijkgraaf, 1952

The actual seat of hearing, the cochlea, shows rather uniform features throughout the whole class of birds (figure 2). As mentioned above for the drum membrane, the cochlea increases relatively but not absolutely with decreasing body size (Schwartzkopff, 1955). Thus, the organs of the small-sized, good songsters (and "hearers") remain smaller than those of large-sized representatives of the same or of other systematic groups. This finding is not easily compatible with the assumption of a peripheral sound analysis by means of spatial separation of sensory elements excited by different tones (resonance theory). The same difficulty arises when one considers that the basilar membrane of a parrot (*Amazona amazonica*) is 2.6 mm. in length (Denker, 1907), whereas that of man with about the same pitch discrimination is 31 mm. Other arguments against peripheral sound analysis are adduced from the compact design of the sensory cells. Thirty to fifty of these lie close to each other in one cross-section of the basilar membrane and remain joined with the tectorial membrane for life (differing in this respect from those of mammals). There are no arcs of Corti by which the hair cells of mammals, arranged in a few separate rows, are each supported and isolated. The steadily increasing width of the basilar membrane—a fundamental support of any resonance theory—is not found in the cochlea

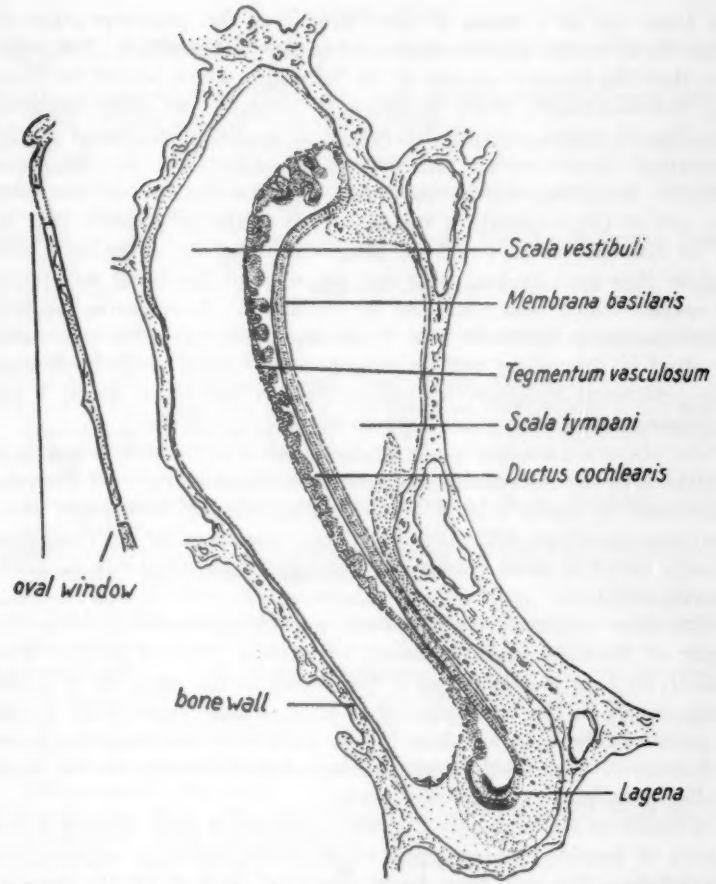

FIGURE 2. The inner ear of the dove; longitudinal section. The oval window has been projected from another plane of section into this one. Notice size and situation of the window in respect to the basilar membrane; these are most commonly reprinted falsely from an erroneous scheme of Satoh.

of birds. Finally, the roof of the canal containing the sensory cells (ductus cochlearis) has become in birds the heavy tegmentum vasculosum, rich in unicellular glands and small blood vessels. Such a structure will damp any resonating vibrations of the inner ear liquor. The corresponding structure in mammals is the peculiarly delicate membrane of Reissner.

Except for the tegmentum vasculosum, which is peculiar to birds,

the inner ear as a whole is more similar to the primitive stage of fishes than to the highly developed organ of mammals. Only the fact that the sensory macula of the labyrinth which serves for hearing (Schwartzkopff, 1949) is distinctly stretched in birds supports the idea of sound analysis by means of spatial distribution of the excitation (length/width relation: parrot 13/1, fish ca. 2/1, man 100/1). According to the subdivision of the ductus cochlearis by the villi of the tegmentum vasculosum it might be possible that 20 to 30 different notes could be projected upon the organ of Corti. But in this way, at best only one per cent of the tonal sensitivity of species which hear well can be explained. In view of the fact that even some fishes are able to distinguish tones quite well (table 3)—that is, they show well developed central sound analysis without any peripheral analyser—sound analysis in the brain must, I am convinced, also be postulated for birds.

The objection readily made against such a hypothesis—that it is a flight into the inscrutable and therefore "illegitimate"—is not substantiated by today's level of electrophysiological technique; even less since important difficulties have been raised against the resonance theory, which is more readily subject to experiments (Ranke, 1953; Wever, 1949).

The idea outlined here has been particularly influenced by the study of Wever's dualistic theory of hearing (Wever, 1949). This author, by careful calculation of the events in the inner ear of mammals, comes to the conclusion that even in that group only a part of sound analysis takes place in the periphery and that the lower and some of the middle tones are transferred directly to the brain (volley principle) and identified there.

It seems to me that only by prosecuting such ideas further can a theory of hearing be developed which is applicable in comparative physiology. We will then have a general picture of the hearing of vertebrates in which mammals stand at the end of an evolutionary trend but do not differ fundamentally from birds or from lower groups, either by the anatomy of their hearing organ or by its physiology.

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NOTES ON A FALL MIGRATION AT MATINICUS ROCK, MAINE

BY ROSARIO MAZZEO

MUCH attention has been given to Matinicus Rock in the Gulf of Maine because of its nesting colonies of petrels, puffins, gulls, and terns, but I am unable to find any recorded observations of the fall migration there. Because of its strategic position at the southeast corner of the island group off Penobscot Bay, it seemed surely indicated that brisk northwest winds would blow many land birds out to it.

Ludlow Griscom had often spoken of the islet, and remarked on the probability of many stragglers touching on such an outlying spot. Spurred on by his encouragement I set about preparations for a stay on the Rock, first obtaining permission from the Coast Guard to live there in one of the small 'war surplus' (World War I) buildings. Ludlow Griscom, Josselyn Van Tyne, and the late Francis H. Allen were kind enough to read this manuscript and have made many valuable comments of which, together with their friendship and encouragement, I am most appreciative.

Landing on the Rock is possible only in good weather, and then only by means of a boat slip on the west side, which is used principally by the Coast Guard. The lobstermen who tend their traps all about this area avoid the slip. A LIFE photographer lost all his gear and cameras in attempting a landing in 1948, and near the end of my stay one of the Coast Guard boys was drowned while attempting a landing. My observations extend from August 27 to September 11, 1949.

Matinicus Rock is situated at Latitude 43° 47′ N. and Longitude 68° 51.3′ W., and is the southeasternmost of the Fox Islands off Penobscot Bay. It is 25 acres in total area, roughly egg-shaped, with the longest dimension northeast to southwest. The widest (also the highest) part is about three-quarters of the distance southwest from the northeast end. With the exception of a little turf on the north side, the islet is a bare rock ridge lifting out of the sea at the northeast end and gradually rising, until after reaching a height of 42 feet at the widest part it drops perhaps 5 to 8 feet for the last 50 yards, and then descends suddenly into the sea. The entire east side is precipitous. The north side shelves off more gradually, with various subsidiary ridges running northwest at right angles to the principal one. Between these smaller ridges are turf areas where the petrels and puffins nest. Also on the north side, and cut off at high tide,

is a tiny rock islet about 25 yards long. The entire island is much worn and creviced, thus providing ideal lee shelters for birds.

A Coast Guard lighthouse station with three men (and a dog) is maintained on the Rock. Because of their many duties, and probably to some extent because of the uncomfortable walking, the men rarely went to the northern end of the island. Even the dog, having had proper warning from the Great Black-backed Gulls, never left the immediate vicinity of the buildings. Besides the light (50,000 candlepower), a radio-beacon and a distance-finding station are maintained, as well as the inevitable fog horn. Via Matinicus Island there is a telephone cable to the mainland.

The nearest island is four and a half miles to the northwest; Ragged Island, now called Criehaven by the natives. Next are Matinicus Island (7 miles northwest), Wooden Ball (10 miles north) and Seal Island (11 miles north). Monhegan, a notable place for bird watching (Allen, 1908: 94; Jenney, 1919: 21; Maynard, 1909: 16; Dewis, 1919: 33; and others) is 18 miles to the westward and visible in clear weather. The nearest mainland point is Sprucehead, 18 miles to the northwest.

Because of its small size and remoteness, Matinicus Rock is an ideal resting place for migrants. My usual practice each day was to make four two-hour circuits of the island. It was possible to examine practically every nook and crevice and thus check daily the continued presence of individual birds that remained several days. Also, because of the exposed nature of the place, many birds could be found only if sought in these sheltered places. Most birds arrived during the nights, but they were not always in evidence on my first morning tour. Particularly when the rocks were wet, footing was very insecure. Many small land birds were impossible to identify because they had disappeared before I found safe footing.

The weather during my stay offered the usual New England variety, with some notably clear days. Winds varied in velocity from 5 to 45 miles per hour, usually between 15 and 35 miles. There were 5 days of east or southeast winds; otherwise (with the exception of one morning of absolute calm) winds were generally west, southwest, or northwest. I paid particular attention to the vicinity of the light during periods of fog. No dead birds were found, but several of the smaller species (petrels, vireos, and warblers) wandered into the engine house. I caught several, and they appeared unharmed. Migrating Monarch Butterflies seemed to maintain a fairly consistent proportion to the numbers of bird migrants, with a high of 75 on September 10.

Although my short stay on the island does not warrant much theorizing, three generalizations seem possible.

1. As amply shown by Gätke (1895: 74–99), Cooke (1915: 4–5), Lincoln (1935: 59–61), and as stated by Clarke (1912: 173, Vol. I), "It must first be remarked . . . that the *direction* of the wind has in itself nothing to do with the results described. The winds and the performance, or non-performance, of the migratory movements are the effects of a common cause—namely, the particular type of weather prevailing at the time, which may be favourable or unfavourable for the flight of birds to or from our islands." It must be remembered that the period under discussion was that when the land-bird migration on the coast of Maine was near its height. Consequently some migration occurred throughout my entire stay irrespective of the direction of the wind. There was not a sufficient number of individuals to attempt to correlate general weather conditions with migration. As on Monhegan (Jenney, 1919: 21), it appeared that some individuals arrived regardless of the wind's direction, but the greatest numbers arrived during very strong northwest winds. There was little difference in the number of species seen on the two islands. Dewis (1919: 33) in a somewhat shorter period on Monhegan recorded 71 species as against my 67.

2. Such 'waves' (two—on September 7 and 10) as did occur came after nights of 25- to 35-mile northwest winds, and represented usually only single individuals of each species, which seemed to arrive as a direct result of being blown out to sea. The Rock was the last land outpost to the south and east for birds subject to the influence of strong northwest winds.

3. One other direct result of the wind was that after the onset of an unfavorable wind (strong west, southwest, or south) all individuals present before the wind-change would be held over. The birds, in the face of the strong head winds, appeared to be unable to fight their way westward to Monhegan (the nearest land in anything like a southerly direction being Cape Cod). Most of the smaller land birds showed signs of fatigue. This, plus the fact that so many species were represented by single individuals, led me to believe that only such individuals appeared on the Rock as were forced out by the strong northwest winds, and only such individuals remained as were forced to remain by the strong west, southwest, or south winds. This was not true of the hawks which will be discussed in the following list. As Trowbridge (1902: 735) reported, the greatest amount of migration occurred soon after the wind veered to northwesterly, especially if it had freshened markedly after a calm. Also

if the wind continued generally in this direction for two or three days the supply of birds migrating dwindled; the greatest movement was soon after the onset of favorable winds.

Annotated List.—Names of forms are given in accordance with the Fourth Edition of the A.O.U. Check-List (1931) and all supplements to date. Palmer (1949) is used throughout as the source of all information regarding status in Maine and former records of species, and may be consulted for a full acount of occurrence. SR—denotes breeding in Maine in numbers and areas such as to warrant expecting the species in the fall coastwise migration. TR—denotes occurrence regularly in fall coastwise flight. Exceptions are explained under species involved.

Greater Shearwater, *Puffinus gravis.*—Non-breeding (biologically wintering) summer and fall resident or visitant. Common on outer offshore waters. August 31 (1), flying west.

Leach's Petrel, *Oceanodroma leucorhoa.*—SR. There were about 200 burrows on the Rock; all that were examined contained a single young bird. Burrows were about 20 to 24 inches in length, invariably turning toward one side or the other, and were approximately horizontal. Bent (1922: 139) mentions burrows up to three feet or more, but none of the ones I observed was more than 24 inches. All were unlined and free of any material except the earth dislodged by my arm. Bent (1922: 139) gives this as the exception, stating that usually there is at the end of the burrow an enlarged chamber containing the nest, which is loosely made of dry grasses, bits of sticks, and weed stems, mixed with pieces of bark and sods.

The chicks were always at the far ends of the burrows and would try to return there as quickly as possible after having been removed. Plumages varied from downy young to almost fully fledged. All had been hatched before August 27, and none had left the island up to September 11. Many were still in downy plumage on the latter date. Photographs were made. The adults were seen on only a few occasions, when single birds were seen coming to burrows at dusk. No song was heard, perhaps because of its being drowned out in the sound of the surf.

Double-crested Cormorant, *Phalacrocorax auritus.*—SR. Always 25 to 60 present, sunning themselves on the rocks or swimming about.

American Eider, *Somateria mollissima.*—SR. Always present in water about the island. Minimum 8, maximum 23.

Goshawk, *Accipiter gentilis.*—SR. Southward movements occur from about October 20 (rarely October 1) through November. One juvenile stayed about an hour, perched on projecting rocks. Easily viewed through 35× telescope.

Sharp-shinned Hawk, *Accipiter striatus.*—SR. September 3 (1), September 6 (1), 8 (1), 10 (4). Palmer says "largest numbers are seen September 4 to 18, chiefly along the coast and even out to offshore Monhegan."

Pigeon Hawk, *Falco columbarius.*—TR. Most Maine fall records are September 5 to 30. September 7 (3), 8 (2), 9 (1), 10 (7), 11 (1). There were no adult males. They were very exciting to watch as they came in from the north. Invariably they arrived in the early morning and with one exception all flew directly toward Monhegan. That one flew due south for about 4 miles (I continued to watch it in the 60× telescope), and then suddenly veered toward Monhegan. I continued

following it for a couple of miles and then lost it. One other flew over the ocean exactly in the manner of a shearwater, barely clearing the water. A few remained until midafternoon.

Sparrow Hawk, *Falco sparverius*.—SR. Seen September 7 (2), 10 (7), and 11 (1). There were no adult males.

Semipalmated Plover, *Charadrius hiaticula*.—TR. August 27 (2).

Ruddy Turnstone, *Arenaria interpres*.—TR. Daily from August 27 to September 4 (2).

Hudsonian Curlew, *Numenius phaeopus*.—TR. Normal flight appears to be from Nova Scotia across Gulf of Maine to Cape Cod. September 2 (1), and 10 (4). Arrived during night and remained entire day. Were still present at 7:30 P.M., but had left before the next morning.

Spotted Sandpiper, *Actitis macularia*.—SR. One always present; September 2 (2).

Solitary Sandpiper, *Tringa solitaria*.—TR. Occasionally found in sheltered places on offshore islands, including Monhegan, usually in August and early September. One was always present; September 3 (2). It was strange to have one so continually present in what must have been inhospitable surroundings. Invariably found on the east side of the island by tiny brackish tide pools at the bottom of 15- to 25-foot crevices.

Greater Yellowlegs, *Totanus melanoleucus*.—TR. September 6 (1) and 10 (1).

White-rumped Sandpiper, *Erolia fuscicollis*.—TR. September 1 (1).

Least Sandpiper, *Erolia minutilla*.—TR. August 31 (12), September 1 (5), 2 (1), 4 (3), 5 (1), 6 (2), and 7 (4).

Semipalmated Sandpiper, *Ereunetes pusillus*.—TR. August 31 (3), September 10 (1).

Sanderling, *Crocethia alba*.—TR. August 31 (1), September 1 (1) and 10 (2).

Great Black-backed Gull, *Larus marinus*.—SR. 100 to 150 present in the area most of the time.

Herring Gull, *Larus argentatus*.—Resident throughout the year. About 100 always present.

Laughing Gull, *Larus atricilla*.—TR. 2 to 6 always present.

Tern (Arctic?), *Sterna* (*paradisaea?*).—SR. September 3 (20), fishing nearby.

Dovekie, *Plautus alle*.—TR. and winter resident. Usually arrive during last five days of October. There are a few summer records for Maine (one in 1910 of a bird seen frequently near Matinicus Rock by the keeper of the light). August 23 (3), perched on rocks.

Black Guillemot, *Cepphus grylle*.—Year-round resident. Always one to three present in surrounding waters.

Atlantic Puffin, *Fratercula arctica*.—Year-round resident. Breeds on Matinicus Rock; according to Harry Watters, keeper of the light during my stay, there were about 60 adult birds in the 1949 nesting colony. August 27 (1) and September 3 (1).

Mourning Dove, *Zenaidura macroura*.—SR. Common in southern part of the state; rare in the eastern and most of the northern part. September 1 (1), 3 (2), 7 (1).

Nighthawk, *Chordeiles minor*.—SR. September 7 (1); stayed all day.

Chimney Swift, *Chaetura pelagica*.—SR. September 4 (1), 7 (1).

Ruby-throated Hummingbird, *Archilochus colubris*.—SR. Migration begins in Maine during first week in August, becoming conspicuous by August 10. On Matinicus Rock, September 10 (1).

Belted Kingfisher, *Megaceryle alcyon.*—SR. September 7 (1).

Flicker, *Colaptes auratus.*—SR. September 7 (1), 9 (1), 10 (3), 11 (2).

Eastern Kingbird, *Tyrannus tyrannus.*—SR. September 7 (1), 8 (1); different individuals.

Empidonax Flycatchers.—Many individuals on September 8 and 10.

Yellow-bellied Flycatcher, *Empidonax flaviventris.*—SR. September 7 (1).

Least Flycatcher, *Empidonax minimus.*—SR. September 7 (3).

Eastern Wood Pewee, *Contopus virens.*—SR. September 7 (1).

Tree Swallow, *Iridoprocne bicolor.*—SR. September 1 (1).

Barn Swallow, *Hirundo rustica.*—SR. September 4 (1), 6 (1), 7 (1).

Raven, *Corvus corax.*—Year-round resident; fairly common on coast. One to three wanderers from more northern islands came occasionally, never staying more than an hour; did not appear to find any food.

Red-breasted Nuthatch, *Sitta canadensis.*—Year-round resident. One to eight present every day. Maximum number on September 7.

Ruby-crowned Kinglet, *Regulus calendula.*—SR. August 31 (1), September 3 (1) and 7 (2).

American Pipit, *Anthus spinoletta.*—SR. on Mt. Katahdin. TR. September 7 (1).

Cedar Waxwing, *Bombycilla cedrorum.*—SR. September 7 (2).

Yellow-throated Vireo, *Vireo flavifrons.*—Occasional SR in southwestern part of state—rare summer visitant throughout the remainder. September 8 (3).

Red-eyed Vireo, *Vireo olivaceus.*—SR. September 10 (1).

Tennessee Warbler, *Vermivora peregrina.*—SR. September 8 (1).

Parula Warbler, *Parula americana.*—SR. September 8 (1).

Magnolia Warbler, *Dendroica magnolia.*—SR. September 5 (1), 6 (1), 7 (5), and 9 (1).

Cape May Warbler, *Dendroica tigrina.*—SR. August 27 (1), September 5 (2), 7 (4), 8 (3), and 11 (1).

Black-throated Blue Warbler, *Dendroica caerulescens.*—SR. September 3 (1).

Myrtle Warbler, *Dendroica coronata.*—SR. September 9 (2).

Black-throated Green Warbler, *Dendroica virens.*—SR. September 8 (1).

Blackburnian Warbler, *Dendroica fusca.*—SR. September 7 (1).

Black-poll Warbler, *Dendroica striata.*—SR. September 6 (1), 9 (1), 10 (1), 11 (1). Plumage differences indicated that they were different birds.

Oven-bird, *Seiurus aurocapillus.*—SR. September 7 (1).

Northern Water-thrush, *Seiurus noveboracensis.*—SR. August 31 (1), September 3 (1) and 4 (1).

Yellow-throat, *Geothlypis trichas.*—SR. September 1 (1).

Yellow-breasted Chat, *Icteria virens.*—Rare visitant—11 records for state listed by Palmer from 1876 to 1948. Only one of these, a bird which remained on Mt. Desert Island from December 1, 1944, for 10 days, was north or east of the present record. August 27 (1), September 2 (1), 4 (1), 5 (1), and 7 (1). Believed to be the same bird throughout. Considering my most careful daily searches, it was a tribute to the bird's elusiveness that it could not be found on the intervening days.

Wilson's Warbler, *Wilsonia pusilla.*—SR. Fairly common fall transient. September 3 (3), 4 (1), 10 (1).

American Redstart, *Setophaga ruticilla.*—SR. September 7 (1), 8 (3).

Bobolink, *Dolichonyx oryzivorus.*—SR. September 3 (2), 4 (1), and 6 (1). It could have been a repeat.

Red-wing, *Agelaius phoeniceus*.—SR. September 4 (1), 5 (2), 7 (1), 11 (1). Different individuals.

Baltimore Oriole, *Icterus galbula*.—SR. Migration occurs in August. Palmer gives only a few later records. September 2 (2), 8 (1), and 10 (1).

Cowbird, *Molothrus ater*.—SR. September 7 (1).

Purple Finch, *Carpodacus purpureus*.—SR. September 9 (1) and 10 (3).

Savannah Sparrow, *Passerculus sandwichensis*.—SR. August 31 (2), September 2 (2), 3 (2), 5 (3), and 7 (6).

Vesper Sparrow, *Pooecetes gramineus*.—SR. Uncommon transient on islands. August 31 (1), September 2 (2).

White-throated Sparrow, *Zonotrichia albicollis*.—SR. September 7 (1).

Song Sparrow, *Melospiza melodia*.—SR. From one to ten individuals daily. Mostly adults. The turnover, considering the early dates, probably indicated that the birds were wanderers from the neighboring islands and not migrants. However, Palmer, (p. 574), says "Migration . . . throughout September."

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Symphony Hall, Boston, Massachusetts, December 27, 1954.

HOMING FLIGHTS AND ORIENTATION OF PIGEONS

HAROLD B. HITCHCOCK

In an earlier paper (Hitchcock, 1952) an account was given of the behavior of flocks of pigeons on homing flights as seen from an airplane. The present account deals with subsequent aerial observation of pigeons homing as singletons as well as in flocks, and with the initial orientation of the birds as observed from the ground. The investigations were made possible through the continued support of the American Philosophical Society, which is gratefully acknowledged. The Army Signal Corps through Mr. Otto Meyer, chief of the Pigeon Breeding and Training Center at Fort Monmouth, New Jersey, provided some of the birds and rendered other valuable assistance. The airplane flights were all piloted by Mr. Robert Hunt of Middlebury, and the aerial observations were made by him and the author jointly.

Fort Monmouth Birds

In 1950, directionally trained Fort Monmouth pigeons released in flocks homed well from the west, the direction in which they had been trained, but poorly when released north of the loft because of a tendency to fly eastward. In 1952, birds were released in the same places as in 1950, but as singletons. Some of them had been trained to home from the west, like the 1950 birds; others had been settled at the loft, i.e., allowed their freedom to fly outside the loft, but not trained; and some had never been permitted to fly outside the loft. These three types will be referred to as *trained*, *settled*, and *non-settled*, respectively. None of the birds used in 1952 had participated in the 1950 program. The places from which the trained birds had flown prior to the 1952 releases are shown in Figure 1.

The same general methods were employed as in 1950. It was found practical to increase the altitude of the plane to about 2000 feet above the birds. No attempt was ordinarily made to follow singletons more than an hour. To facilitate the reporting of strays, each bird wore on its leg, in addition to its number band, a conspicuous plastic capsule with a request that the finder notify the author of the time and place the bird was found. These messages proved to be of value, for of 49 Fort Monmouth birds lost in the 1952 flights, reports were received on 16, and 2 birds were reported twice. In 1950, 27 Fort Monmouth birds were lost, all banded but without message, and none was reported. The birds were taken by plane to the release points early on the day of the flight and liberated late in the morning

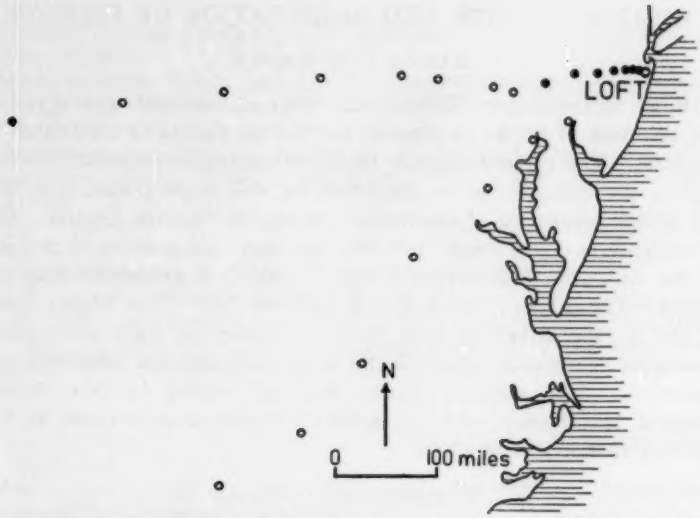


FIGURE 1. Release points from which trained Fort Monmouth birds had flown prior to experimental flights. Solid circles, training stations; open circles, racing stations.

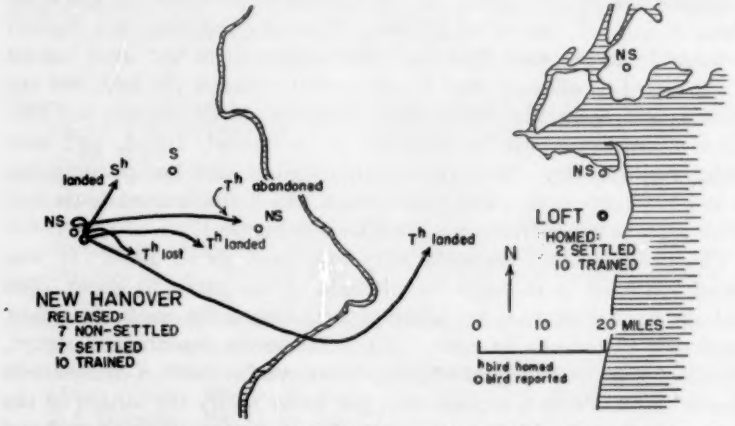


FIGURE 2. Homing flights of Fort Monmouth; singletons from New Hanover. Flights observed from plane are indicated by solid lines. NS, non-settled bird; S, settled bird; T, trained bird.

and during the afternoon. Daylight Saving Time, one hour earlier than Standard Time is referred to.

Not all birds were followed by plane, owing to limitations of time and funds. Conditions at the release points were unfavorable for extensive observation from the ground, and records of orientation were made only of birds that were followed by plane. Meteorological data are given in the Appendix.

Flights from New Hanover, Pennsylvania, 85 miles west of the loft. Figure 2. (*a*) *Trained birds.*—Ten one- and two-year-old birds were released on June 28. Nine had homed from westerly points 250–515 miles from the loft, and one from the 100-mile point, but none had ever been released at New Hanover. The four birds followed by plane flew well in the direction of the loft. The only bird that was followed more than an hour rather closely duplicated the course of one of the 1950 flocks, dipping southward into the suburbs of Philadelphia and then overcompensating to the north. This bird landed at 5:27, soon after the sun had sunk behind a cloudbank near the horizon, the rest of the sky remaining clear. Three birds homed on the day of release, at 7:45, 8:53, and "late in the evening," the exact time of the last not being known, five on the day following, and one each on the fourth and eighth days. The sun set at Fort Monmouth on June 28 at 8:27. The fastest return was made in 2 hours 46 minutes, 8 minutes slower than the faster of the two flocks in 1950, each of which homed without losses on the day of release.

(*b*) *Settled and non-settled birds.*—Seven settled and seven non-settled birds, all youngsters, were released on June 27. The only settled bird followed by plane landed 10 miles northeast of New Hanover after a flight of 19 minutes; it homed two days later. One other settled bird homed, on June 28, and another was reported on June 28, 15 miles northeast of the release point. No other settled birds were reported. Five of the non-settled birds landed immediately after being released and the others disappeared quickly behind nearby trees. Four were reported, three of them in positions indicating good orientation, the fourth 2 miles west of New Hanover.

Flights at Wurtsboro, New York, 90 miles north of the loft. Figure 3. (*a*) *Trained Birds.*—On June 29 and July 1, eleven birds were released, seven of which had homed from New Hanover, and the others of similar age and training. There was a general tendency to fly eastward. Seven birds homed, three of them on the day of release (including the two one-day birds from New Hanover that were flown), the others later. Six of the successful homers from New Hanover returned, but the seventh was reported 85 miles east of Wurtsboro.

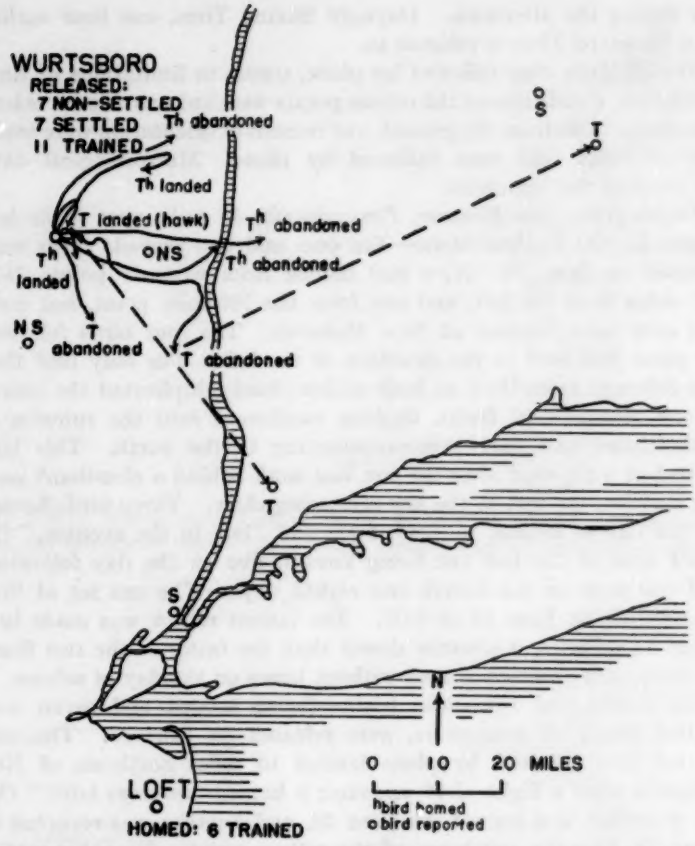


FIGURE 3. Homing flights of Fort Monmouth singletons from Wurtsboro. Broken lines join position at which followed birds were last seen to place at which they were later reported.

In 1950, two flocks of 20 birds each homed 32 birds, 19 of them on the day of release. These flocks, like the singletons, flew easterly, part of one flock reaching New Haven, Connecticut, 85 miles southeast of Wurtsboro, before heading toward the loft.

(*b*) *Settled and non-settled birds.*—Seven settled young birds were released on June 29. The only one followed by plane flew aimlessly in the vicinity for 35 minutes before being abandoned in flight. None homed, and only two were reported. Seven non-settled young birds were also released on June 29. Four landed at once and the others

disappeared behind nearby trees within 2 minutes. Two were reported, both close to Wurtsboro. None homed.

Flights at Ballston Spa, New York, 190 miles north of the loft. ***Figure 4.*** (*a*) *Trained birds.*—Ten birds were released on July 22. The five that were followed by plane took easterly courses, four of them decidedly to the northeast. Three of the four that were reported were again from the east, two of them on the seacoast. None homed. In 1950 a flock of 23 trained birds flew easterly after a period of indecisive flight; four of them homed.

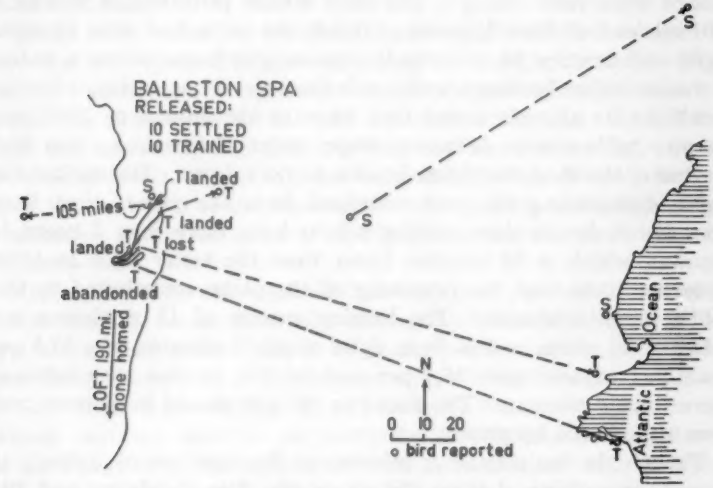


FIGURE 4. Homing flights of Fort Monmouth singletons from Ballston Spa.

(*b*) *Settled birds.*—Ten were released on July 22, four of which were followed. Three of these birds landed within two miles of the release point after flights of 6, 12, and 27 minutes, respectively, and the fourth landed four miles north after 19 minutes of aimless flight. None homed. Reports were from the east and northeast. One bird was reported twice, first 75 miles east-northeast, and then at 180 miles in approximately the same direction; another reached the seacoast. No non-settled birds were released at Ballston Spa.

Discussion of the behavior of the Fort Monmouth Birds. (*a*) ***Trained birds.***—The performance of singletons (1952) was inferior to that of flocks (1950). Losses were higher and homing times slower. Kramer and von St. Paul (1950: 624) have reported similar experience. One might anticipate some confusion on the part of birds released as these were for the first time as singletons, their training having been in

flocks. It is likely, however, that all had homed part way alone since flocks normally become dispersed on flights as long as these birds had experienced. Differences in weather in 1950 and 1952 do not appear to have been significant.

The flight of the singletons as observed from the plane was more erratic than that of flocks in most instances. During the orientation period, changes in the direction of flight were frequent and abrupt; in some cases changes in altitude were conspicuous. The paths of several birds were marked with frequent deviations from side to side, though some were steady. The most erratic performance was by a bird released at New Hanover. It left the airport at once in rapid flight and flew for 28 minutes in various directions within a radius of 5 miles before landing about a mile from the release point. During this flight its altitude varied from close to the ground to 2000 feet. Despite such erratic behavior while under observation, this bird was one of the three that homed on the day of release. Its true homing flight, disregarding the part witnessed from the plane, must have been direct, for its time could not have been more than 2 hours 18 minutes, which is 20 minutes faster than the faster flock in 1950. It seems likely that the proximity of the plane contributed to this bird's initial confusion. The homing success of 13 singletons not followed by plane, or lost from sight within 2 minutes, was 62.5 per cent, as compared with 55.5 per cent for the 18 that were followed more than 2 minutes. The flocks in 1950, it should be pointed out, were all followed by plane.

Though the ten singletons released in the direction of training all homed, only three of them did so on the day of release, and two required more than two days. In 1950, 43 birds in two flocks all homed the day of release. Counterbalancing the inferior performance of the singletons as a whole is the performance of the three that did home the same day, all of them well after the usual time for pigeons to stop flying. Matthews (1953a: 254–255) reports, for example, that in a large number of flights none of his pigeons homed after sundown, and less than 1 per cent as late as an hour before sundown.

The tendency to orient in the direction of training rather than toward the loft was marked at both points off the training line. At Wurtsboro, the northeasterly tendency might have been influenced by the direction of the valley in which releases were made, but at Ballston Spa, where the same northeasterly trend was conspicuous, the terrain lacks features that would seem to influence orientation. Reports on birds that failed to home indicate that the easterly tendency persisted far beyond the release area. The singletons were all at least one year

old and had two or more seasons of training, whereas the 1950 flocks were of birds less than a year old and only one season of training. The performance of the more experienced birds, though disappointing from the angle of homing, seems to reflect their ability to respond to training—to fly in a particular compass direction. It appears that the younger birds in 1950, not having learned their lesson in directional training so well, were better able to revert to orientation toward the actual loft position. However, as pointed out below, birds without training also showed the same eastward tendency at the northern release stations.

Settled birds.—At New Hanover, the two birds that homed and the one that was reported suggest an ability to orient to the loft. None homed from the other locations. At Wurtsboro, two were reported, one in the direction of the loft and the other to the east. At Ballston Spa, two made long flights to the east, and one a short flight north. *Non-settled birds.*—None of the non-settled birds homed, but at New Hanover two of the three that were reported made flights that terminated within 25 miles of the loft, and one remained near the release point.

Although conservative opinion has been that pigeons do not home unless trained, recent work with settled birds by Matthews (1953b) and non-settled (aviary) birds by Kramer and von St. Paul (1954) has clearly shown that such birds can orient toward the loft and home to it. Thus the behavior of well-oriented untrained birds in the present account calls for no particular discussion. The similarity in the behavior of the untrained birds to the trained ones in flying an easterly course when released north of the loft, however, raises certain questions. *The experience of some of the birds may not have been as represented.* One can suspect that in the large lofts at Fort Monmouth, records of individual birds may not always be accurate. *They followed trained birds with a directional bias.* No bird was released until the preceding one was out of sight, usually after an interval of several minutes. At Wurtsboro there is little likelihood that the settled birds were influenced by the trained birds, as the latter were released two days after them. Only once, while under aerial observation, did two experimental birds meet in flight. This instance occurred when a bird was inadvertently released while the one being followed was over the airport. *Local topography influenced the direction of flight.* The earlier aerial observations revealed certain preferences for type of terrain to be flown over, ridges and wooded areas being selected rather than level ground and cleared land, but the eastward tendency could not be accounted for on this basis.

At Wurtsboro some of the birds appeared reluctant to leave the valley in which they were released, following it rather than climbing high enough to leave it while under observation. However, birds reported from Wurtsboro releases were well beyond the valley, so that it seems unlikely that local topography influenced flights for any great distance in a particular direction. *They had been genetically selected to fly eastward.* It is conceivable that the Fort Monmouth birds through generations of selection for good homing from the west could have an innate preference for flying easterly when finding themselves in a strange locality. The ability of pigeons to orient to a particular compass direction has been demonstrated by a number of investigators, and as shown by the easterly tendency of Fort Monmouth birds at Wurtsboro and Ballston Spa, orientation to a compass direction may override the more primitive ability of orienting toward the loft. However, the birds in the Middlebury flock, though of Fort Monmouth origin, have not shown an eastward tendency. *Conditions of an as yet unknown sort favored the easterly course.* Racing pigeon fanciers and investigators are familiar with instances of false orientation at places where departures have customarily been good. Similarly, it is known that at certain points pigeons rather consistently orient falsely. It is unfortunate, in trying to evaluate this possibility, that at Ballston Spa, the only place where both Middlebury and Fort Monmouth birds were released, the direction of Middlebury is roughly the same as that taken by the Fort Monmouth birds. Of these various possible explanations the last seems not the least unlikely, especially since Kramer (unpublished) has observed that in certain places both his trained and untrained birds show a tendency to orient consistently in a false direction. Another example of the tendency of birds to fly consistently in a direction that does not necessarily lead them homeward has been reported by Griffin and Goldsmith (1955), who observed that Common Terns (*Sterna hirundo*) when released inland at several places in New England take a southeasterly course regardless of the direction of their nesting area. In this case the suggestion is made that such a tendency may be correlated with the position of the coastline when the birds find themselves inland. The eastward tendency of the Fort Monmouth pigeons at northern release points, however, would seem to have no such utilitarian explanation.

BEHAVIOR OF "DETRAINED" PIGEONS

My flock at Middlebury, Vermont, received more training in 1950 from the southeast than from other directions, and when releases were made in two novel directions the birds oriented and homed

poorly (Hitchcock, 1952). At Ballston Spa, southwest of the loft, a flock split up soon after its release and the birds followed by plane flew northwest, in the direction of training. At Massena, New York, northwest of the loft, the flock also fragmented soon after release, and the birds followed flew two great circles before settling down to a steady course.

In 1952, the flock was trained in a way designed to remove any bias on the part of survivors from 1950 for flying northwest by being given 28 releases, the most distant of which was 35 miles from the loft, before the first aerial observations were made. The direction of the release point was changed each time, and the places were for the most part ones where releases had not been made previously. Between experimental flights additional releases in random directions were also made. Throughout the experimental period nesting boxes were removed from the loft and the birds given two exercise periods daily. On August 13, the date of the first aerial observation, the flock consisted of 19 birds, 16 of them veterans from 1950, and three yearlings. On October 10, 24 days after the last experimental flight, ten veterans and one yearling remained. The experimental flights are shown in Figure 5.

Flights from Worcester, Vermont, 40 miles northeast of the loft.—Eighteen birds were released in flocks of six each on August 6 at the airport, in a narrow valley flanked by hills rising 2000 to 3000 feet. Following orientation flights of 7, 7, and 4 minutes, respectively, each flock headed well toward the loft, over high ground, but each practically reversed its direction after a few miles, and only one of them could be followed to the loft. Seven birds homed the first day, six the next, and four later in the week. The one bird that failed to return was reported 20 miles east of the loft. (This bird was kept captive, but escaped in August, 1953, and returned directly to the loft.)

Flights from Ballston Spa, New York, 76 miles southeast of the loft.—On August 19, 15 birds in flocks of three, six, and six were followed. The first flock (A), composed of three birds that had homed from Ballston Spa in 1950, showed considerable indecision and remained near the airport half an hour. Two of the birds were lost 17 miles north of the release point after several minutes of circling, but the third was followed over a good course to within three miles of the loft. Two homed on the day of release, and the third on the day following. The second flock (B) left the release point immediately, flying westerly, like the flock followed in 1950. The birds were under observation for 3 hours 10 minutes, but only during the last 40 minutes did they indicate orientation toward the loft. Three homed the same day,

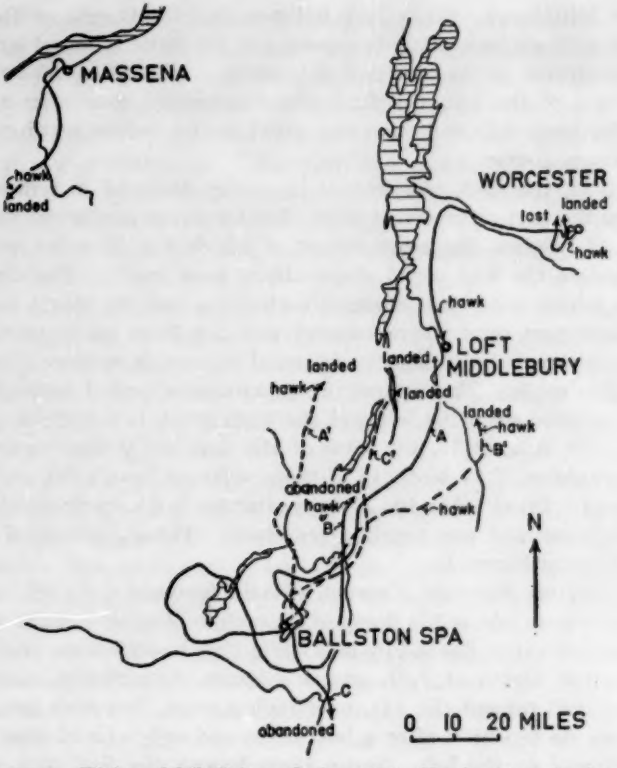


FIGURE 5. Flights of Middlebury flocks, 1952. Hawk, attack by hawk.

one much later, and one was lost. The third flock (C) was abandoned over the city of Troy after mixing with local pigeons. Five returned the next day; one was lost.

On September 9, the survivors of the August 19 flights were released again at Ballston Spa in the same groupings. All flocks (A', B', and C') made short orientation flights and headed well toward the loft. Five homed the same day, two the following day, four later, and one was lost.

Flights from Massena, New York, 106 miles northwest of the loft. Ten birds were released on September 16. Two that were released as singletons started off at once in the direction of the loft but were lost too soon for one to be sure that the true homing flight had begun. One of them homed the second day and the other, which was the only one flown in 1952 that had homed from Massena in 1950, returned

in seven days. A flock of four flew aimlessly near the airport 36 minutes, losing one member, and then headed southwest. One of this group (very possibly the one that separated from the others at the start) homed the next morning, another three weeks later, and two were lost. A second flock of four was released but not followed. Two of these birds returned the next day, another 21 days later, and one was lost. Seven out of ten birds homed in 1952, as compared with three out of ten in 1950.

Discussion of the performance of "detrained" birds.—The 1952 flights were not without a suspicion that the bias to fly in a northwesterly direction had not been completely eliminated by training. At Worcester, the one flight followed to completion was for a considerable distance after the first few well directed miles in a westerly direction, and one of the Ballston Spa flights closely duplicated the first part of the westward course flown by the 1950 flock, though with a subsequent orientation toward the loft. The flock followed at Massena showed great indecision upon release, and flew finally in a westerly direction. These improper orientations may be the result of as yet unrecognized stimuli that tend to produce false orientation at certain places, as mentioned above in the case of the Fort Monmouth birds. Other flights in the 1952 series, however, indicated a better orientation, and the homing performance was distinctly superior. Some of the improvement may, of course, be attributed to the loss of the poorer homers during 1950.

Why the three flocks at Worcester should have started off in the right direction and then practically reversed their course is not clear. In one case a hawk attack precipitated the change in direction, but in the others no such stimulus was apparent. In each instance, the birds were flying close to the ground, and it appeared as though they might have been reluctant to continue their proper course because of difficulties in the terrain ahead—a mile-wide valley and then a mass of mountains.

Though the Middlebury birds have been followed through mountainous country without significant alteration in their course because of the terrain, they have on several occasions exhibited an apparent reluctance to descend from an altitude at which they have been flying when the ground beneath them dropped away. At times they have followed a contour on a slope rather than maintaining a true course, and occasionally flocks have circled briefly upon reaching the end of a ridge they have been following. The flock that was followed to the loft from Worcester kept at a fairly constant elevation, not far above the treetops, as it flew westward, losing altitude gradually

as it entered the Champlain Valley. However, these birds, after setting their course for the loft, passed directly over Mount Philo, an isolated 600-foot peak rising from the valley, that could have been avoided by a slight deviation in course.

INITIAL ORIENTATION

In 1953, the orientation of the Middlebury birds was studied by observing the direction of their departures from the release point. This technique, which both Kramer and Matthews have employed in their field studies of orientation, has the advantages over aerial observation of being inexpensive and of eliminating the possible disturbing influence of the plane.

TABLE 1

HOMING RESULTS

Place	*Date*	*Released*		*Homed day of release*		*Homed second day*		*Homed third day*		*Homed later*		*Lost*	
		Tr.	*Sett.*	*Tr.*	*Sett.*	*Tr.*	*Sett.*	*Tr.*	*Sett.*	*Tr.*	*Sett.*	*Tr.*	*Sett.*
Bremen	July 16	13	—	0	—	0	—	0	—	6	—	7	—
Bremen	Aug. 13	—	8	—	0	—	0	—	0	—	1	—	7
Glastonbury	July 29	12	—	0	—	1	—	0	—	1	—	10	—
Glastonbury	Oct. 4	3	8	0	0	0	0	0	0	3	1	0	7
Maryland	Aug. 4	12	—	0	—	0	—	2	—	2	—	8	—
Maryland	Oct. 18	3	9	0	0	0	0	0	0	0	1	3	8
Norwich	Nov. 1	3	9	0	0	1	0	0	1	1	1	1	7
Williamstown	Nov. 22	1	10	0	0	0	3	1	1	0	2	0	4
Totals		47	44	0	0	2	3	3	2	13	6	29	33

Seven groups of releases were made from 75-foot forest observation towers and one from the ground. The direction in which the birds disappeared while viewed through 6- or 7-power fieldglasses was recorded as indicative of the bird's orientation. Both trained and settled birds were used. Most of the former were yearlings with training up to 20 miles in random directions from the loft; the rest were birds whose experience has been described above. The settled birds were all hatched in the spring and early summer of 1953. Nesting was permitted throughout the summer and the birds allowed to fly at will. The trained birds were given four, 10-mile flights in different directions early in the summer, but the settled birds' first experience at being caged was on the experimental flight. With a single exception, noted below, each bird participated in only one flight. Each bird bore a message capsule. At stations where two releases were made, only trained birds were flown on the first release.

TABLE 2

ANALYSIS OF INITIAL ORIENTATION[1]

	Bremen[2]		*Glastonbury*		*Maryland*		*Norwich*	*Summary*			
								Trained birds		*Settled birds*	
	July 16	*Aug. 13*	*July 29*	*Oct. 4*	*Aug. 4*	*Oct. 18*	*Nov. 1*	*Homed*	*Lost*	*Homed*	*Lost*
Number of pigeons	13	5	11	12	11	12	12	18	26	5	27
Mean angular deviation regardless of sign	26°	32°	54°	29°	97°	78°	80°	55°	68°	74°	57°
Standard deviation	26°	32°	80°	28°	49°	42°	44°	40°	54°	65°	44°
Probability that such scatter could have arisen by chance[3]	0.01	0.1	0.65	0.01	0.75	0.6	0.6	0.035	0.2	0.65	0.02

[1] Williamstown is not included because observation of departures was not made like the others.

[2] Values greater than 0.05 indicate scatter that cannot be differentiated from random. Calculations made according to method of Matthews, '53a, p. 244.

[3] The flock was counted in the computations as 5 birds rather than as a single unit.

The pigeons were transported to the release points by car in such a way that they could not see their surroundings, left overnight on the towers and released in the morning. The Bremen birds were kept one night and day inside a building 11 miles south before being placed on the tower. While on the towers the birds were permitted to view their surroundings. At Williamstown, where releases were made from the ground, the birds viewed their surroundings from their arrival at 10:45 A.M. until released at 12:30 and 1:30 P.M. the same day. Three of the release points were at distances greater than any of the birds had previously flown, and the others were stations that had not previously been used. Orientation, homing and meteorological data are given in Figures 6 to 9. Homing results are tabulated in Table 1 and an analysis of orientation given in Table 2.

The release at Bremen (Figure 6) on July 16 gave convincing evidence of orientation toward the loft. Eight singletons and a flock of 5 all left the tower without hesitation and disappeared im-

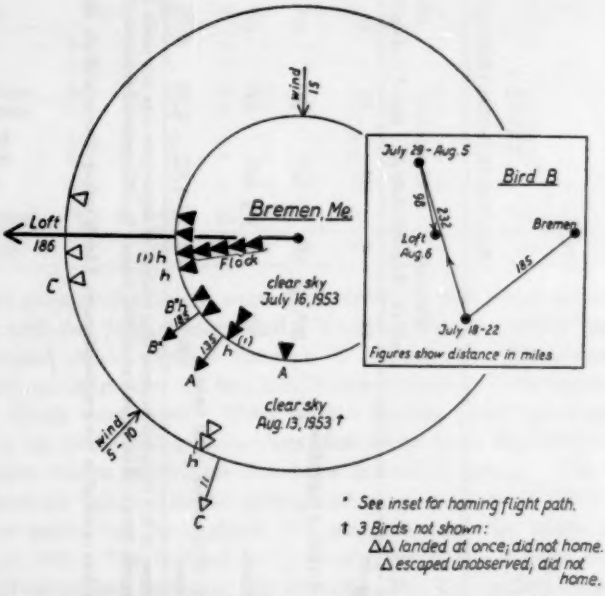
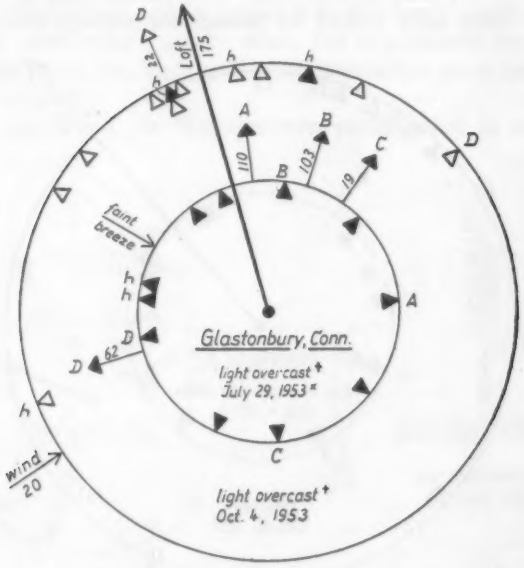


FIGURE 6. Orientation of Middlebury birds at Bremen. Pointers indicate direction in which birds disappeared. Solid pointers, trained birds; empty pointers, settled birds. Outward arrows, direction and distance in miles at which birds were reported. Inward arrows, direction and velocity (miles per hour) of wind. h, bird homed; capital letters, birds reported.

mediately in straight, well-directed flight. Seven settled birds released there later oriented more slowly and less accurately. At Glastonbury (Figure 7) the departures of the first group were in random directions. Possibly noise from a radio in the tower room where they spent the night affected their behavior, for the later group that was kept on a lower level of the tower had good orientation. Within a few hundred feet of the Glastonbury tower, a radio relay station operates 24 hours daily. The signals are concentrated into a narrow beam to one side of the observation tower, but some birds undoubtedly flew through it. The signals have a frequency of about 4,000 megacycles, and about one-half watt is used to direct the beam. These signals do not appear to have influenced the orientation of the birds.

At Maryland (Figure 8) the first group oriented randomly. The second group also showed random orientation, but there was a bunching at about 60° from the loft direction. Departures in both cases were slow. At Norwich (Figure 9) departures were also in random



x▲ escaped unobserved; did not home.
+ intermittent sunshine

FIGURE 7. Orientation of Middlebury birds at Glastonbury. For explanation, see Figure 6.

directions and after long orientation flights. Bird B, whose homing flight from Bremen is shown in Figure 6, was released at Norwich and returned on the 46th day, this time without progress reports. At Williamstown (Figure 9) the birds were released in groups of 5 and 6. Each started its flight eastward, apparently to take advantage of sloping ground to gain altitude quickly, and then turned north and disappeared without wavering in its course. Because trees blocked sight of the flocks at about a quarter of a mile, the performance of these birds is not included in the analysis of orientation in Table 2.

DISCUSSION: INITIAL ORIENTATION OF MIDDLEBURY BIRDS

The generally poor performance in orientation, and homing as well, was disappointing in view of the decidedly superior performances reported by both Kramer and Matthews. Whether the Middlebury birds were genetically poorer than those of the other investigators or whether they had to perform under greater handicaps of management, weather, and topography is not clear. All were from a flock built up over a period of five years through selection of birds able to home. They were picked by chance for various releases. The

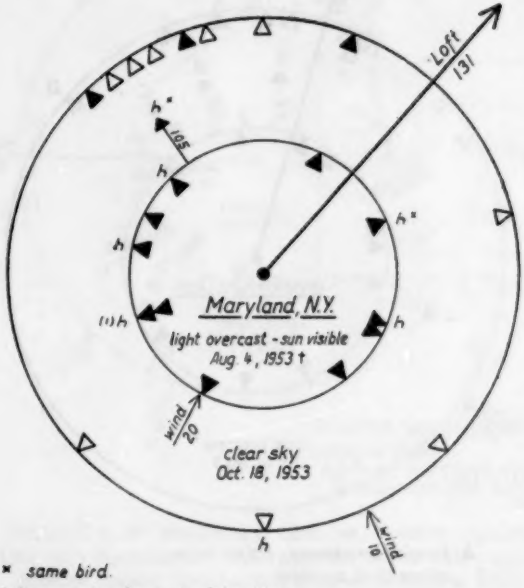


FIGURE 8. Orientation of Middlebury birds at Maryland. For explanation, see Figure 6.

fact that orientation was not random at Bremen (July 16), Glastonbury (October 4), and probably at Williamstown suggests that unrecognized factors interfered with the effective utilization of the birds' abilities on other occasions. As might have been expected, those of the *trained birds* that homed showed a significant orientation toward the loft, whereas those that failed to home showed random orientation (Table 2). It is not particularly surprising, especially in view of the small numbers of birds concerned, that among the *settled birds* the orientation of those that homed was not as good as that of those that failed to home, for homing success is influenced largely by experience whereas orientation is innate (see Matthews, 1953b).

The best substantiated theory of orientation in homing birds is the sun navigation theory of Matthews (1953a). The theory postulates a very accurate time sense and the bird's ability to compare the sun's altitude and position in azimuth where the bird is with similar conditions at the loft. It has received support from Matthews' observation that birds orient poorly in overcast weather. These observations are also in accord with Kramer's (1952) discovery that caged birds orient poorly when the sun cannot be localized. They suggest that the birds utilize in orientation wave lengths that are visible to man.

In this connection the Williamstown performance is of interest,

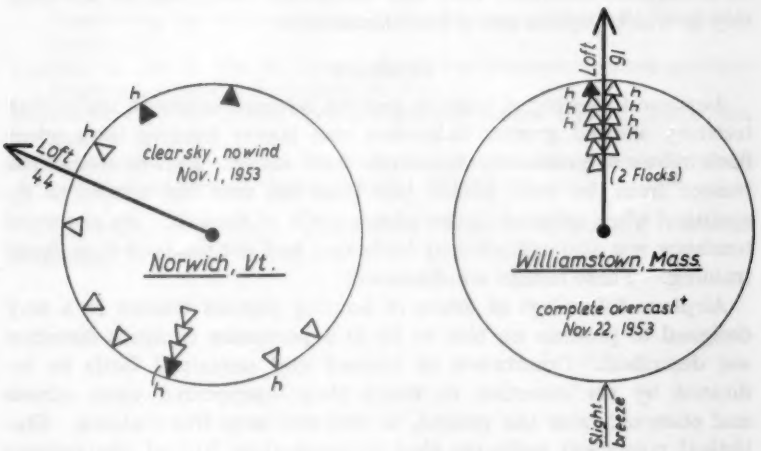


FIGURE 9. (left) Orientation of Middlebury birds at Norwich. (right) Orientation of Middlebury birds at Williamstown. For explanation, see Figure 6.

for here the birds apparently oriented promptly and three of them subsequently homed under a heavy overcast through which the sun's position could not be distinguished. Bees can orient when the sun's position is obscured by overcast, and von Frisch (1953) has recently reported that this ability is lost if light from the ultraviolet end of the spectrum (3000–4000 Å) is prevented from reaching them. Experimentation should soon show whether the pigeon can utilize similar wave lengths in orienting itself.

Though pigeons are reluctant to fly at night, they can be trained to do so. Correspondence with pigeon fanciers in Hawaii indicates that pigeons are regularly raced at night there. The birds are released one hour after sundown and race time expires one hour before sunrise. The course customarily flown, about 95 miles from Puunene on the island of Maui to Honolulu, includes two stretches of about 18 and 25 miles across water. Night fliers cover this course in times comparable with those of day birds. The greatest distance over which pigeons are raced is 140 miles, from Upolu Point, Hawaii, to Honolulu, with an over-water stretch of about 20 miles. Returns on this course have not been good. In the Hawaiian Islands, where homing might more understandably depend upon the recognition of land masses than on a less limited continental area, one may question whether navigation is involved. The night-flying Hawaiian pigeons and the performance of the Middlebury birds at Williamstown both suggest, however, that sun navigation may not be the only way in which pigeons can orient themselves.

SUMMARY

Airplane following of homing pigeons released singly in unfamiliar territory showed greater indecision and poorer homing than when flock releases, previously reported, were made. Experienced birds trained from the west, homed best from the west but tended to fly eastward when released at two places north of the loft. An eastward tendency was also exhibited by birds that had not received directional training. These results are discussed.

Airplane followings of flocks of homing pigeons trained in a way designed to produce no bias to fly in a particular compass direction are described. Orientation of trained and untrained birds as indicated by the direction in which they disappeared upon release and observed from the ground, is recorded from five stations. Statistical treatment indicates that in more than half of the releases orientation was of a random sort. These results are discussed. The orientation of birds under total overcast is discussed in relation to Matthews' theory of sun navigation.

APPENDIX

Weather Conditions for Flights in 1952

June 27—sky 40 per cent filled with cumulus clouds; visibility 10 miles; wind 5 miles per hour from south.

June 28—partly cloudy, but sun's position apparent; visibility 5 miles; no wind.

June 29—in morning overcast but sun's position apparent; improvement in afternoon to 80 per cent cloud-free sky; visibility good; no wind.

July 1—scattered cumulus clouds; visibility unlimited; no wind.

July 22—scattered cumulus clouds; visibility unlimited; wind 15 miles per hour from northwest.

August 13—sky 40 per cent filled with cumulus clouds; visibility unlimited; wind 15 miles per hour from northwest.

August 19—sky almost cloudless; visibility unlimited; weak wind from west.

September 9—sky almost cloudless; light haze; wind 5 miles per hour from southwest.

September 16—sky 60 per cent filled with cumulus clouds; visibility unlimited; wind 20–25 miles per hour from west.

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Department of Biology, Middlebury College, Middlebury, Vermont, November, 5, 1954.

CENSUSING SOUTHERN MICHIGAN SANDHILL CRANES

BY LAWRENCE H. WALKINSHAW AND HAROLD F. WING

THE SANDHILL CRANE (*Grus canadensis tabida*) population in southern Michigan reached a low point during the middle 1930's. From that time to the present there has been a gradual increase. We conceived the idea that it was not impossible to census the cranes in southern Michigan, so we organized a group of cooperators during the winter of 1951–52 to carry on this work in the spring of 1952. A few cooperators under the leadership of Walkinshaw followed through during the 1953 and 1954 seasons. With three summers work completed, we have a much better idea of the marshes used.

METHODS OF STUDY

1. A list of all known crane marshes in southern Michigan was made.

2. Aerial photographs of all counties where marshes occurred were studied, and a series covering the known crane-inhabitated areas as well as those areas which appeared as possible nesting areas was purchased.

3. We prepared a concise one-page list of suggestions for cooperators. They were advised to communicate with property owners during the early spring and to determine the best access to their marshes. Most marshes were accessible only with hip-boots and the remainder only by boat. We tried mainly to select cooperators who were young or middle-aged men. We suggested that they condition themselves for the hard marsh work and that they search during the latter part of the nesting season, late April or early May, to prevent desertion of nests.

4. Each cooperator received a copy of the suggestions and, when necessary, an aerial photograph of his area and a county highway map.

5. Where obtained, records of migration were kept, including numbers of birds observed. Location and contents of nests were listed. If it was not possible to locate the nest, observers worked from some high spot near the marsh, if possible, to locate the approximate site of the unfound nest.

6. To prevent nest desertions, we tried to have only one person or one group working on each area so that there would be no chance of two people or groups going to one nest about the same time.

7. Through Dr. Donald Douglass, all of the Game Managers of the Michigan Conservation Department throughout southern Michigan reported their crane observations to us.

8. During August and September, counts were made on all areas to tally family sizes. During mid-October, the larger concentrations were observed and compared with the earlier counts. A few departure dates were recorded.

9. With many farmers, we discussed the rareness of the crane, its nesting and feeding habits, and the necessity for its protection, hoping to gain future benefits as we have in the past.

COOPERATORS AND AREAS COVERED

Thirty-eight people, plus the Rose Lake staff, helped us with this cooperative project as follows:

SANILAC COUNTY: Harold Tubbs, L. H. Walkinshaw, and Dale A. Zimmerman.

CLINTON COUNTY: Dr. and Mrs. C. T. Black and the Rose Lake staff, Arnold Boersma, R. H. Brocke, Marvin Cooley, Alvin Derke, Ed Kelly, Dr. Miles D. Pirnie, L. H. W., and John C. Watling.

BARRY COUNTY: H. Lewis Batts and L. H. W.

EATON COUNTY: Robert Cornell, Merrill Gilfillan, and L. H. W.

INGHAM COUNTY: Marvin Cooley, M. D. Pirnie, L. H. W., and Harold F. Wing.

LIVINGSTON COUNTY: Lawrence Camburn, Marvin Cooley, Dr. and Mrs. W. Powell Cottrille, Philip S. Humphrey, Holton Knisely, Douglas Middleton, Clarence Owens, Ralph O'Reilly, Clyde Van Gorder, L. H. W., and Robert Whiting.

LAPEER COUNTY: Martha Lengemann, L. H. W., Dale A. Zimmerman, and Dr. L. M. Zimmerman.

CALHOUN COUNTY: Robert Cornell and L. H. W.

JACKSON COUNTY: Leon Alger, Ralph Bailey, Robert S. Butsch, Dr. and Mrs. W. Powell Cottrille, Merrill Gilfillan, Ronald Mayer, Jack Mock, Clarence Owens, M. D. Pirnie, Gotlieb Rothman, Charles Shick, Loyal Walker, L. H. W., Eldon Whiteman, Robert Whiting, and H. F. Wing.

WASHTENAW COUNTY: Ralph Bailey, Andrew J. Berger, Dr. and Mrs. W. Powell Cottrille, Philip S. Humphrey, Clarence Owens, L. H. W., and H. F. W.

In addition Walkinshaw and Whiting reported on Cheboygan County; Clarence Owens and Walkinshaw on northern Hillsdale County; Martha Lengemann, Dale A., and Dr. L. M. Zimmerman on St. Clair County; and Oscar M. Bryens on St. Joseph County.

Dr. Donald Douglass and District Game Supervisors, Marvin Cooley, Ralph Bailey, Roy Semeyn, and Harold Tubbs of the Michigan Department of Conservation helped over many areas not covered by others.

The following land-owners also aided us in this study: Wynn Boyce, E. Clark, John Czapla, John Denton, Claire Frinkle, Dan Hall, Clayton Huggett, Louis Schumacher, and Charles Yoakam.

It is possible that some cranes might nest in the northern portion of the Lower Peninsula, but no records, except during migration, have come from this area for many years.

We would have liked to census the cranes of the Upper Peninsula but deemed it an impossible task. However, during 1952 Walkinshaw was in the Upper Peninsula from May 22 to 29, June 21 to 28, and August 29 to September 1. William Dyer was with him on the

second trip; Harold Wing on the third. During the May trip he found five crane's nests:

(1) Chippewa County, T45N, R5W, Section 22. May 22, 1952, two newly hatched young in nest.
(2) Chippewa County, T45N, R5W, Section 15. May 22, 1952, nest with two eggs.
(3) Luce County, T48N, R10W, on an island in Sleeper Lake. May 23, 1952, parent incubating eggs.
(4) Mackinac County, T44N, R9W, Section 3. May 24, 1952, nest with two eggs, one of which was pipped.
(5) Schoolcraft County, T47N, R13W, Section 19. May 28, 1952, remains of broken eggs in nest. In this same marsh William Dyer and Walkinshaw found a newly-hatched downy young June 23, 1952.

Spring Migration

When the crane concentration at Jasper-Pulaski Game Preserve in northern Indiana reaches its peak in late March and early April, apparently all southern Michigan cranes have been on territory for some time. On March 29, 1952, we counted 862 cranes at Jasper-Pulaski; on March 28, 1953, Mr. and Mrs. John Bunnell, Ida Suttman, and Jim and L. H. Walkinshaw counted 1019 cranes. Yet in 1953, the southern Michigan cranes had arrived on their respective marshes as early as March 2.

Southern Michigan Census Results

With the exception of one group, all of the Sandhill Cranes were found in a somewhat diamond-shaped area in the south central part of the Lower Peninsula. The approximate distances along the sides of this diamond were 50, 44, 38, and 67 miles. The census of the different marshes is shown in Table 1.

Recent Increase

In Jackson County, the Mud Lake and Portage marshes harbored ten pairs of breeding cranes during 1952 and the surrounding marshes 12 pairs, a total of 44 per cent of the southern Michigan population. During 1953, these areas harbored 18 pairs or 39 per cent of the population, and during 1954, 16 pairs or 37 per cent.

During 1935, covering the entire marsh on two different days, Walkinshaw found only one pair of cranes on the Mud Lake, Leoni Township, Jackson County marsh; on May 2, 1948, we found three nests with eggs; during 1952, five pairs nested there, and during 1953, six pairs; this was apparently down to four pairs in 1954. Twenty to twenty-two non-breeders spent the summer there in 1952; 11 to 12

TABLE 1

MICHIGAN AREAS SURVEYED AND TOTAL NUMBER OF CRANES FOUND

County, Township, and Sections	*1952*			*1953*			*1954*		
	Pairs	*Young*	*Non-breeding birds*	*Pairs*	*Young*	*Non-breeding birds*	*Pairs*	*Young*	*Non-breeding birds*
SANILAC COUNTY,									
(1) Watertown Twp. (T11N, R14E), Sects. 2, 11	1	1	0	0	0	0	0	0	0
CLINTON COUNTY									
(1) Victor Twp. (T6N, R1W), Sects. 32, 33	0	0 5		2	1 5		2	1	0
(2) Bath Twp. (T5N, R1W), Sect. 4	1	1		1	0		1	0	0
(3) Bath Twp. (T5N, R1W), Watling's Marsh, Sect. 14	1 N	0	0	1 N	2	0	1 N	2	1
(4) Bath Twp., Rose Lake, Sect. 26	1	1	0	1	0	0	1 2y	1	0
(5) Bath Twp., Grass Lake, Sects. 21, 28	2 N	3	0	1	2	4	1	2	0
(6) Bath Twp., Park Lake, Sects. 32, 33	1	1*	0	1	0	0	1	1	0
BARRY COUNTY									
(1) Johnstown Twp. (T1N, R8W), Sect. 24	1 N1e	0	0	1	2	0	1	1	0
EATON COUNTY									
(1) Bellevue Twp., Sect. 24 Walton Twp. (T1N, R5, 6W), Sect. 19	1	1	0	1	1	1	0	0	0
INGHAM COUNTY									
(1) Meridian Twp. (T4N, R1W), Lake Lansing, Sect. 2	1	?	0	0	0	0	0	0	0
LIVINGSTON COUNTY									
(1) Deerfield Twp. (T4N, R5E), Hoisington-Bennett Lakes, Sect. 1	1	0	2	1	1	0	1	1	1
(2) Iosco Twp. (T2N, R3E), Sect. 26	1 N2e 1y	1	0	1 N2e 1y	0	1S	1 N2e 1y	1	0

TABLE 1 (Continued)

County, Township, and Sections	*1952*			*1953*			*1954*		
	Pairs	*Young*	*Non-breeding birds*	*Pairs*	*Young*	*Non-breeding birds*	*Pairs*	*Young*	*Non-breeding birds*
LIVINGSTON COUNTY—Continued									
(3) Unadilla Twp. (T1N, R3E), McIntyre Lake, Sect. 31	2	1	0	1	2	0	1	2	6F
(4) Unadilla Twp. (T1N, R3E), Bass Lake, Sect. 25	2	2	5	1	1	2S	1	0	0
CALHOUN COUNTY									
(1) Pennfield Twp. (T1S, R7W), Sect. 12	1	0	0	0	0	0	0	0	0
(2) Convis Twp. (T1S, R6W), Mud Lake, Sect. 5	0	0	0	1	1	0	1	2	7F
(3) Convis Twp., B. W. Baker Sanct., Sects. 10, 11, 14, 15	2 N2e	1	1	2	1	3	2	1	4S 1F
(4) Convis Twp., Kinyon Lake, Sect. 12	1 N2e	0	1	1 N2e	0	0	1	0	0
(5) Marshall Twp. (T2S, R6W), Sect. 6	1	2	0	1 N2e	1	1	1	0	0
JACKSON COUNTY									
(1) Springport Twp. (T1S, R3W), Sects. 3, 10, 11, 15, 22, 23	3	3	5	4	2	5	3 N2e 1y	3	0
(2) Leoni Twp. (T2S, R1E), Mud Lake, Sect. 2	5 N2e N N 1y	3	22S 20F	6 N	4	12S 11F	4 N	5	13S 19F
(3) Waterloo Twp. (T1S, R2E), Big Portage Lake, Sects. 30, 31	1 Ne Ne	1	0	1	2	0	0	0	0
(4) Waterloo Twp., Little Portage L., Sects. 29, 32	0	0	0	0	0	0	1	1	0
(5) Waterloo Twp., 4-Lakes, Sect. 17	2 N2e	1	0	0	0	0	0	0	0

TABLE 1 (Continued)

County, Township, and Sections	*1952*			*1953*			*1954*		
	Pairs	*Young*	*Non-breeding birds*	*Pairs*	*Young*	*Non-breeding birds*	*Pairs*	*Young*	*Non-breeding birds*
JACKSON COUNTY—Continued									
(6) Waterloo Twp., Whitehead L., Sects. 2, 3, 10, 11	2	3	5	1 2y	2	0	2	1	4S
(7) Waterloo Twp., Merkle Lake-Schumacher Marsh, Sects. 14, 23	2	3	0	2	0	0	2	1	0
(8) Waterloo Twp., Portage Marsh Sects. 21, 22, 27, 28, 34	5 N2e	3	0	5 N2e	3	19S 15F	4 N	5	6S
(9) Waterloo Twp., Spring Lake, Sect. 35	1	1	0	1	1	0	1	2	0
(10) Waterloo Twp. (T2S, R2E), Sect. 3	1	0	7	0	0	0	0	0	0
(11) Hanover Twp. (T4S, R2W), Sects. 5, 8	1	1	2	1	1	2	1 N2e	1	0
(12) Grass Lake Twp., Sects. 22, 23; Norvell Twp. (T3S, R2E), Sect. 26, Bessey Lake	1	1	5	2	2	0	1 N1e	1	8
(13) Norvell Twp. (T3S, R2E), Sect. 33	?			?			1	0	0
WASHTENAW COUNTY									
(1) Lyndon Twp. (T1S, R3E), Boyce Lake, Sect. 8	1 1y	1	0	1 1y	1	0	1 N2e	1	0
(2) Lyndon Twp., Joslin Lake, Sect. 3		Unknown		1	2	6F	1	0	0
(3) Lyndon Twp., Sects. 9, 10, 11, 14	0	0	0	1	0	0	1	0	0
(4) Lima Twp., Sect. 4; Dexter Twp., Sect. 33, 4-Mile Lake (T1, 2S, R4E)	1	1	0	1 1y	2	0	1	1	21S
(5) Sylvan Twp. (T2S, R3E), Sect. 31	1	1	0	1	1	0	1	2	5
(6) Sharon Twp. (T3S, R3E), Sect. 8	1	1	2	1 N2e	1	7	1	0	0
SOUTHERN MICHIGAN TOTALS	49	39	62S 60F	47	39	62S 60F	43	39	63S 48F

Non-breeders in groups as found.

N—Nest (N2e—Nest and 2 eggs. These nests are recorded as observed, some we watched from the highway and did not go, preferring not to disturb the birds.)

y—young in or near nest. S—Spring; F—Fall; *—young bird known to have been shot by hunter.

in 1953; 13 to 19 in 1954. During 1952, one of the adults from a nest near the highway joined the non-breeders only 100 meters from the nest, at their roosting spot at night, a divergence from the normal behavior.

TABLE 2

SUMMARY OF SOUTHERN MICHIGAN SANDHILL CRANE COUNTS 1952–1954

	1952		*1953*		*1954*	
	Number	*Per cent*	*Number*	*Per cent*	*Number*	*Per cent*
Total spring count	160		156		149	
Breeding pairs	49*	61.25	47	60.26	43	57.72
Number of pairs producing no young	15	31.25	17	36.17	15	34.88
Number of pairs producing one young	27	56.25	21	44.68	17	39.53
Number of pairs producing two young	6	12.50	9	19.15	11	25.58
Total number of young produced	39		39		39	
Average number of young produced per pair	0.812		0.829		0.907	
Per cent of fall population which were breeders		49.74		48.71		49.71
Spring non-breeders	62		62		63	
Fall non-breeders	60		60		48	
Total fall count	197		193		173	

*—One pair in 1952 was not found in the fall so it was not known whether they produced any young or not.

Under breeding pairs the percentage listed was the per cent of total cranes found.

A similar increase has occurred at the Portage Marsh, Jackson County. Cranes have appeared for the first time in many smaller marshes throughout the crane-inhabitated area in the eight counties. In some, like Mud Lake, Convis Township, Calhoun County, they appeared during the 1930's, disappeared during the fall of 1951, then reappeared in 1953. Cranes first appeared at the Hoisington-Bennett Lake area, Livingston County during 1950; Bellevue, Eaton County, marsh during 1935; Kinyon Lake, Calhoun County during the 1940's; Marshall Township, Calhoun County, marsh during 1951; into new areas in Jackson County and Washtenaw County even in small marshy lake borders where people disturbed the birds very little. During the three summers, 38 marshes were used; 32 during 1952, 31 during 1953, and 31 during 1954.

AUTUMN MIGRATION

An indication of the recent increase of cranes in Jackson County has been the larger autumn flocks in the Waterloo-Portage Marsh

SANDHILL CRANE IN MICHIGAN. The two aerial photographs show the same area. The one taken in 1940 (*left*) shows the location of a nest found by Lawrence H. Walkinshaw April 30, 1939. The second aerial photograph (*right*) shows the same area August 14, 1949; it has changed little to date (1953). The greater part of the marsh has been drained and is under cultivation, mostly spearmint. At the north end where the drain was stopped, the overflow crosses a very small marsh. Here during 1952 and 1953, Walkinshaw again found crane nests as marked on the map; the Cottrilles found a nest just a few meters to the north in 1954.

FIGURE 1. Summer distribution of the Sandhill Crane in Michigan, 1930–1954. Closed circles represent actual nesting records; open circles, sight records. Outline map copyrighted by Rand McNally and Co. and reproduced with their permission.

area often going in more recent years, because of hunting pressure in the former marsh, to the Whitehead Lake area. These birds disperse during the mornings into northeastern Jackson, southwestern Livingston, and northwestern Washtenaw counties. On October 6, 1940, Walkinshaw counted 46 cranes in the Portage Marsh; October

9, 1941, 45; Black counted 48, October 17, 1942; Walkinshaw, 36, October 10, 1943; the authors, 40 on October 15, 1944; Wing, 38, October 6, 1945; the authors, 68, October 8, 1949; Wing, 84, October 14, 1951, then 98, October 12, 1952; Bertha Daubendiek, 99, October 7, 1953; and Walkinshaw, 81, October 2, 1954. These counts were made in the evening or early morning at the roost. The largest counts each year were similar to the total census results we made in the immediate areas indicating that the Waterloo flock consists of cranes from that area alone.

A similar concentration has occurred at the Springport Marsh, Jackson County. There were 14 in October, 1952; 15 in the fall of 1953, and 9 in 1954 (the Cottrilles, Van Tyne, Walkinshaw). A similar group has increased at the Baker Sanctuary in the autumn (Auk, **67**: 43, 1950). During 1953, 29 cranes were observed on this area October 28, nine remaining until November 15 (Walkinshaw). In the Bath Township, Clinton County, areas concentrations have occurred in the past. These birds have been holding their own, and 28 were counted here the first week in September, 1953, by Walkinshaw. These fall concentrations together totalled about 180 cranes in 1952; 189 in 1953; 157 in 1954.

On the other hand, larger flocks of low-flying cranes have been noted near Lansing on two occasions: 50–65 by Zorb, October 15, 1952, and 50 by E. Goff, October 1, 1950. These could have been northern Michigan cranes in migration. They have been observed in other parts of northern and western Michigan also.

ADDITIONAL NOTES

Possible errors in this study are many. However, our work does give some idea of the number of cranes in southern Michigan. We do not know how many pairs were so extremely quiet when we worked over their marshes that we missed them. We know that certain areas were not covered sufficiently, a few only by local farmers; and that probably some marshes were overlooked. We know that the dispersal of non-breeders caused some difficulty. However, in the majority of marshes, we were certain of the numbers. With the work we did during the three years as well as in the past, we feel that we are not very far off in our totals. The return of cranes to nesting in marshy lake borders has produced some difficulty, for they return just long enough to nest, then spend the late summer and fall on other areas. Our final totals are somewhat substantiated by the addition of fall concentrations. How many of these we have missed we do not know.

Although we do not have the total of hours spent by cooperators in the crane study, Walkinshaw spent 405 hours in 1952 on 122 field trips, during which he drove 5936 miles and walked an estimated 194 miles. Except for five mornings, he was in the field by 4:00 to 4:30 A.M. daily between April 12 and May 10. During 1953, he spent 190 hours on 81 field trips and drove 4739 miles.

SUMMARY

A census was made of the southern Michigan Sandhill Crane population during 1952, 1953, and 1954 by 38 observers plus several Michigan Conservation Department personnel and a few farmers. This study was made possible by the use of recent aerial photographs, highway maps, and much hard work. Studies in recent years by the authors aided it a great deal. Cranes were found in nine counties in the Lower Peninsula. Although impossible to census the cranes in the Upper Peninsula, nests were found in Chippewa, Luce, Mackinac, and Schoolcraft counties in 1952.

Cranes usually arrive in southern Michigan in March but occasionally in late February. The young of the previous year, driven away by the parents, now congregate in non-breeding flocks, roosting in the marshes at night and feeding during daytime on surrounding higher ground. The breeding pairs nest in the larger marshes, often around marshy lake borders in the central portion of southern Michigan from Bath Township, Clinton County, and Deerfield Township, Livingston County, on the north, to Marshall Township, Calhoun County, and Sharon Township, Washtenaw County, on the south. One pair was found in Sanilac County in 1952. The main area in which the cranes were scattered is somewhat diamond-shaped with the sides 50, 44, 38, and 67 miles long. In this area, plus the one in Sanilac County, were found 38 crane-inhabitated marshes. During 1952, 32 were occupied; during 1953 and 1954, 31.

In 1952, 48 pairs of cranes produced 39 young that could fly. In the spring there were 62 non-breeders; in the fall 60. In 1953, we found 47 breeding pairs which also produced 39 young. Again there were 62 non-breeders in the spring and 60 in the fall. During 1954, only 43 breeding pairs were found, but they also produced 39 young. There were 63 non-breeders in the spring but only 48 were found in the fall. Since birds often roam about, some may have been missed.

In the spring flock of 1953, 94 were breeding cranes and 62 non-breeders indicating that young of at least two years constituted the total. This would indicate that cranes do not breed until at least three years old. In all probability, they become paired during their

third summer and may not nest until four years of age. A crane census in Michigan should give about 60 per cent breeders in the spring and 49 per cent in the fall.

Cranes from several marshes concentrate during the fall at night roosts in isolated marshy spots. The largest of these flocks has occurred in Waterloo Township, Jackson County, where 98 cranes were counted October 12, 1952; 99 on October 7, 1953; 81 on October 2, 1954. These fall concentrations helped verify our summer census results in that the total of different areas was very similar to our census results, about 180 in 1952, 189 in 1953, and 157 in 1954. Last cranes were observed at the Baker Sanctuary in 1952, November 1; in 1953, November 15; at Mud Lake, Calhoun County in 1954, November 7.

Up until 1952 there has been a steady increase in the southern Michigan cranes since the 1930's. The appearance of cranes in new marshes is evidence of this; the increased numbers in the fall concentrations, also.

Chances of error are listed: unfound marshes; presence of nonbreeders; movements of pairs between marshes on occasion; insufficient coverage.

1703 Wolverine-Federal Tower, Battle Creek, Michigan, and 7165 Bunker Hill Road, Jackson, Michigan. January 5, 1954.

SEASONAL CHANGES IN THE ENERGY BALANCE OF THE ENGLISH SPARROW

BY EARLE A. DAVIS, JR.

In attempting to explain why an organism is to be found in a given habitat at a given time of the day or year, the ecologist is actually trying to indicate how the organism's physiological, anatomical, and behavioristic adaptations are integrated to permit it to maintain a favorable energy balance with its environment.

The study of bioenergetics in birds is simplified by the fact that they are homoiothermic. Kendeigh (1944), using the English Sparrow (*Passer domesticus*), found that the body temperatures of acclimated birds during the winter did not change after exposures from 37° C. to −40° C.; therefore, the rate of heat production must have been equal to the rate of heat loss. Later, again using English Sparrows in the winter phase of the yearly cycle, Kendeigh (1949) found that the food energy absorbed per gram bird per day on a 10-hour photoperiod increased linearly with a drop in temperature at the rate of 0.0108 Calories per degree Centigrade (Figure 1). Realizing the possible importance of feeding time (photoperiod) in this problem, Seibert (1949) subjected winter-adapted English Sparrows to 15 hours of light, simulating local summer daylight hours. The data thus obtained gave a linear regression when metabolized energy was plotted against the temperature to which the bird was subjected. However, this regression slope was not as steep as that for the 10-hour birds, being 0.0046 Calories per degree Centigrade.

The purpose of the present investigation is to study the energy balance of summer-adapted English Sparrows on 10-hour and 15-hour photoperiods and to compare the data obtained therefrom with that obtained on winter-adapted birds. It should then be possible to state quantitatively the general trend of the changes of energy balance occurring in this species throughout the yearly cycle as it exists in nature.

This paper is based on a doctoral dissertation, research for which was performed in the Zoology Department of the University of Illinois under the guidance of Dr. S. Charles Kendeigh to whom I am indebted for supervision and criticism through frequent consultation. I am also indebted to the following men for giving so generously of their time and advice: Doctors J. W. A. Brant, R. M. Forbes, T. S. Hamilton, H. W. Norton, and H. M. Scott. I also wish to express my gratitude to Dr. Hamilton for allowing the use of the Animal Science Department's Parr adiabatic oxygen bomb calorimeter and to Mr.

A. Kosowski for help in the construction and maintenance of experimental equipment.

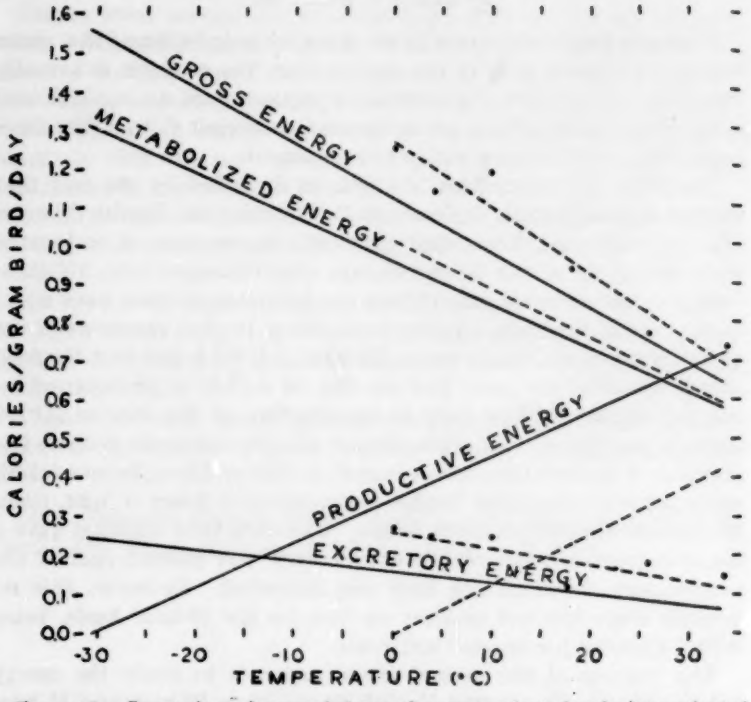

FIGURE 1. Comparison of energy balance of summer-adapted and winter-adapted English Sparrows. Regression lines for summer-adapted birds (broken lines) are averages for individuals exposed to 10- and 15-hour photoperiods; those for winter-adapted birds (solid lines) are for individuals exposed to 10-hour photoperiod (Kendeigh, 1949). The following formulae apply to summer-adapted birds: gross energy in Cal./gm. bird/day: 1.27–0.0167 T.; excretory energy: 0.26–0.0040 T.; metabolized energy: 1.02–0.0127 T.; productive energy: 0.0127 T.

EFFECT OF CONSTANT TEMPERATURE AND PHOTOPERIOD

Procedure.—Data for the present studies are limited largely to results obtained within the months of May through October and with birds captured during those months. Experiments were run for four summers, 1949 to 1952 inclusive. Most of the birds were caught in nets placed at night over the entrance to the nest; however, a few were also caught by drop traps and funnel traps. New individuals

were used for each set of temperatures, except in a few instances. Equal numbers of males and females were employed to permit detection of any sex differences in response. Although there is some uncertainty concerning the correct differentiation of immature and adult female birds during the first summer, checking the ossification of the skull at the termination of each experiment verified age determinations in all later experiments.

In determining energy balance, the method followed in this study has been to measure food consumption and excrement loss. The energy intake, viz., food consumption or gross energy (G.E.), is limited to daylight hours (Seibert, 1949; Eyster, 1952). The excretory energy (E.E.) is subtracted from gross energy to determine the metabolized energy (M.E.).

Existence energy is the composite of energy required for the maintenance of standard metabolism plus the energy involved in physical and chemical heat regulation, in securing food and drink under most favorable conditions, and in the heat increment or "specific dynamic action" incident to digestion and assimilation. Both Kendeigh and Seibert assumed that metabolized energy under the conditions of their experiments was equivalent to existence energy since their birds maintained a constant weight and no surplus work was performed. If the processes of anabolism and catabolism are equal, all of the food absorbed is being utilized. Therefore, in the discussion which follows, the term metabolized energy has been substituted for the term metabolizable energy commonly used by nutritionists.

Productive energy represents that portion of the total potential food absorption which is over and above the energy required for existence at any particular temperature. This energy is expendable for growth, locomotion other than that involved in obtaining food and drink under optimum conditions, migration, reproduction, molt, and fat deposition. Within the temperature range employed in these experiments, the birds required the least existence energy at the highest temperatures and progressively more energy with decreasing temperatures, reaching presumably the maximal metabolized energy intake at the lowest temperatures they were able to endure. Then, as was stated by Kendeigh (1949: 120–121): "If this 'maximum' energy intake could also be attained at higher temperatures when demands for purposes other than heat production required it, the productive energy would be the difference between the potential energy intake and the energy required for existence."

In an effort to maintain the birds at the existence energy level, they were placed in small one-half inch hardware cloth cages identical

in size (10″ × 10.5″ × 5″) with those used by Kendeigh (1949) and Seibert (1949). Following confinement after capture, the bird's weight typically fell rapidly for two to four days, then leveled off to a constant weight within six to ten days, the rate and duration of fall being proportional to the total weight loss. The average amount of weight lost by birds following confinement was 3.3 grams (11.4 per cent), with females losing an average of 1.7 grams (5.5 per cent) more than males (Table 1). The maximum difference in weight loss

TABLE 1

COMPARISON OF INITIAL AND AVERAGE EXPERIMENTAL WEIGHTS. EXPERIMENTAL BIRDS WERE CAUGHT BETWEEN APRIL AND JULY. HOWEVER, AVERAGE EXPERIMENTAL WEIGHTS WERE OBTAINED THROUGH OCTOBER

Month	*Number of birds*	*Sex*	*Initial average weight in grams*	*Average experimental weight in grams*	*Per cent of weight loss*
April	4	Female	32.6	25.2	21.4
	2	Male	28.3	25.2	11.3
	6	Female & Male	30.4	25.2	16.4
May	12	Female	28.7	25.2	12.2
	8	Male	28.0	25.1	10.4
	20	Female & Male	28.4	25.1	11.3
June	12	Female	27.0	24.8	8.1
	9	Male	27.6	25.8	6.5
	21	Female & Male	27.3	25.3	7.3
July	10	Female	27.8	24.4	12.2
	9	Male	27.2	25.4	6.6
	19	Female & Male	27.5	24.9	9.4
	Final average	Female	29.0	24.9	14.1
		Male	27.8	25.4	8.6
		Female & Male	28.4	25.1	11.4

between males and females, amounting to 4.3 grams (10.1 per cent), occurred in the month of April. Visual comparison of the sex organs of freshly caught birds with those of birds sacrificed at the termination of experiments suggested that the greater weight loss of the females was due in part to the comparatively greater retrogression of the ovary and accessory organs. After the weight leveled off, the bird was maintained under experimental conditions for about three weeks. Averages of data were made only for periods when the birds maintained a constant weight and energy exchange. For purposes of investigating the effects of prolonged cage confinement, several birds were maintained under constant conditions for four months or longer. It was necessary to place only one bird in a cage in order to maintain a minimum of activity.

Each cage was set in a four-inch-deep metal tray with a double thickness of full-size newspaper between the cage and the tray. One-

half inch wooden blocks were used to elevate the cage above the paper. This arrangement caught grain particles tossed or kicked out by the birds and provided greater cage sanitation. In spite of the eight- to ten-inch-high curtain made by the newspaper and various ways of offering the food, some slight amount of food was lost by scattering. In all instances every effort was made to arrange the cages so that the lighting within was as uniform as possible.

The birds were weighed at three-day intervals, the cages were cleaned, the papers were changed, and weighed amounts of fresh food were given the birds. The food offered was not dried, but the dry weight was calculated. The food and excrement which had fallen to the newspapers were dried overnight in an incubator maintained at 55° C. The following day the uneaten food and the feces were separated, first by sifting the mixture through a sieve and then sorting through the siftings for small pellets. Since the substances were dry, it was possible to take the pellets between the finger tips and rub off adhering food particles. This permitted a more accurate separation of the two substances than had been possible in the work done by Kendeigh and Seibert, who had done their separating immediately after cleaning the cages. The food and feces were then dried for two or three more days in a 95° C. dry-heat oven until a constant weight was attained on successive daily readings. All measurements of the bird's weights, food, and excrement were done on a triple beam balance to the closest one-tenth gram.

The food used was the same ground, mixed chicken mash, University of Illinois Number 393, used by Kendeigh and Seibert. On an average, their mixture contained 15 per cent protein, 11 per cent moisture, and had an energy value of 4.4 Calories per gram of dry weight. For the present investigation, tests were made on the caloric value and water content of each 100 pound sack of feed. The caloric value of the feed (and feces) was determined in a Parr adiabatic oxygen calorimeter. In making computations of gross energy, the specific caloric value obtained for each sack of food was used. The average of these values was 4.261 Calories per gram, which approximates the figure (4.4 Calories per gram) used by Kendeigh and Seibert. Since the moisture content of the food varied only two per cent during the years 1949 through 1951, the average (12.0 per cent) was used to compute the dry weight of the gross energy consumed for these years. The moisture content of the food used in 1952 was definitely less, averaging 9.4 per cent; therefore, this figure was used for this latter year.

The amount of food supplied each bird varied with the tempera-

ture to which the bird was being subjected. Occasionally at lower temperatures it was necessary to introduce an additional amount of weighed food before the end of a three-day period. Only as much food was provided as the bird would likely eat; for, if a surplus of food is supplied, an animal may eat selectively (Forbes and Grindley, 1923).

Water was made available in cups suspended from the side of the cage. Fresh water was provided each day.

The temperature range employed in this experiment was 0° to 34° C. The maximum temperature is that at which this species survives longest without food (Kendeigh, 1934). The lower limit was set by the fact that summer birds placed at temperatures below 0° C. on a 10-hour photoperiod failed to survive more than a few days. In determining the lower limit, two freshly caught summer-adapted birds and two birds previously held at 10° C. for one month were subjected to a temperature of −10° C. on a 10-hour photoperiod. Since all four of these birds died within two or three days, a similar group of four birds was placed at −5° C. These birds also died within three to four days. Birds placed at 0° C. succeeded in maintaining themselves. Kendeigh (1934) found that at −10° C. birds without food can survive only 10 to 11 hours. Even on a 15-hour photoperiod with nine hours darkness, the birds would be very weak at daybreak and feeding probably would be reduced during the day.

Temperatures of 34°, 18°, 10°, and 4° C. were maintained through the use of constant temperature units of the walk-in type. Experiments at 0° C., and occasionally 4° and 10° C., were conducted in a smaller refrigerator unit. Experiments at 26° C. were run in a basement room well insulated from the out-of-doors where fluctuations in temperature between night and day did not vary more then ±2° C.

All rooms were light-proof, and each was illuminated by two 100 watt, incandescent, frosted bulbs. The average light intensity inside the cages was 11 footcandles, which approximates the minimum of 10 stated by Burger (1949) as being adequate for normal activity. The light period was regulated by an automatic time switch. The 10-hour photoperiod, 7 A.M. to 5 P.M., was used to simulate winter conditions, and the 15-hour period, 7 A.M. to 10 P.M., to simulate summer conditions. Since no molt of feathers comparable to that obtained by Lesher and Kendeigh (1941) resulted from sudden changes in the photoperiods, birds were shifted immediately from one photoperiod to another without intervening gradual steps.

Results.—Useful records were obtained from 70 birds, 33 of these being at the 10-hour photoperiod and 37 at the 15-hour photoperiod.

The valid readings obtained from these individuals were the equivalent of 1962 individual bird days, 1153 from birds exposed to 10 hours of light, while 809 came from the 15-hour group.

A. *Weights.*—The extreme range in average body weights for individual birds was 8.0 grams, or from 29.0 to 21.0 grams. Comparisons of weights between the various temperature groups and within the groups themselves are shown in Table 2. There is no significant difference in the average weight of birds at different temperatures.

TABLE 2

COMPARISON OF AVERAGE WEIGHTS DURING CONSTANT TEMPERATURE EXPERIMENTS AT DIFFERENT PHOTOPERIODS

Temperature (°C)	*Number of birds*	*Average weights in grams*	*Standard deviation*
		10-hour photoperiod	
0	6	25.6 ± 0.54	1.32
4	4	26.6 ± 0.94	1.87
10	4	25.1 ± 1.04	2.09
18	5	24.9 ± 0.59	1.31
26	7	25.1 ± 0.60	1.58
34	7	25.4 ± 0.72	1.91
		15-hour photoperiod	
0	6	24.6 ± 0.91	2.23
10	7	24.9 ± 0.26	0.70
18	8	26.0 ± 0.70	1.99
26	10	24.1 ± 0.57	1.79
34	6	25.2 ± 0.69	1.70

Data on weights, gross energy, excretory energy, and metabolized energy obtained on birds which were confined at constant temperatures for long periods were not sufficient in number nor in uniformity of occurrence to permit significant statistical analyses. Two birds kept for about two and one-half months maintained approximately the same energy balance throughout the duration of the experiment. One bird kept for four months showed a negative energy balance as indicated by a decline in weight, gross energy, excretory energy, and metabolized energy; another individual was able to maintain the same weight while its gross energy and excretory energy declined and its metabolized energy increased slightly.

B. *Gross energy.*—Kleiber and Daugherty (1934), working with domestic fowl chicks, found that with decreasing air temperature the amount of food consumed per day increased as a straight line. Similar results have been obtained in the current series of experiments (Table 3). Figure 1 indicates that in the present investigation the

TABLE 3

GROSS ENERGY CONSUMPTION PER BIRD PER DAY UNDER CONSTANT TEMPERATURE CONDITIONS

Temperature (°C)	*Number of birds*	*Total days feeding*	*Average Calories gross energy*	*Standard deviation*
		10-hour photoperiod		
0	6	221	33.3 ± 1.24	3.05
4	4	135	30.4 ± 1.78	3.57
10	4	97	30.2 ± 1.30	2.59
18	5	117	22.3 ± 0.84	1.87
26	7	176	18.8 ± 0.83	2.21
34	7	407	17.5 ± 1.46	3.88
		15-hour photoperiod		
0	6	139	29.3 ± 0.89	2.17
10	7	177	29.6 ± 1.01	2.68
18	8	145	25.1 ± 1.42	4.02
26	10	213	18.8 ± 1.33	4.22
34	6	135	20.3 ± 1.24	3.49

TABLE 4

GROSS ENERGY CONSUMPTION PER BIRD PER HOUR UNDER CONSTANT TEMPERATURE CONDITIONS

Temperature (°C)	*10-hour photoperiod*	*15-hour photoperiod*	*Per cent difference*
0	3.33	1.95	41.4
4	3.04	—	—
10	3.02	1.97	34.8
18	2.23	1.67	25.1
26	1.88	1.25	33.5
34	1.75	1.35	22.9

linear relationship between the amount of food ingested (G.E.) and temperature changes at the rate of 0.0167 Calories per gram bird per day per degree C.

On comparing gross energy consumed per day by winter-adapted birds on a 15-hour and a 10-hour day at the same temperature intervals, Seibert (1949) found that they ate more at high and moderate temperatures on the longer photoperiod but that at low temperatures they ate equivalent amounts. In the present investigation there were no significant differences in the amount of food consumed on the 10- as compared with the 15-hour day at any given temperature.

If a given amount of food is to be consumed in a unit of time, while in another similar set of conditions it is to be consumed in a shorter length of time, naturally the rate of consumption will be more rapid in the second case than in the first. While the exact amount of time—number of hours—that the birds actually were feeding at each photoperiod is not known, on an average the amount of food eaten per

TABLE 5

DETERMINATIONS ON CALORIC CONTENT OF FECES OF BIRDS MAINTAINED AT CONSTANT TEMPERATURES

Temperature (°C)	*Number of tests*	*Average number of Cal./gm.*	*Standard deviation*
		10-hour photoperiod	
0	4	3.740 ± 0.025	0.049
4	2	3.439 ± 0.061	0.086
10	2	3.664 ± 0.032	0.045
18	5	3.893 ± 0.053	0.117
26	3	3.682 ± 0.064	0.110
34	5	3.546 ± 0.094	0.209
		15-hour photoperiod	
0	6	3.699 ± 0.025	0.062
10	5	3.734 ± 0.049	0.109
18	8	3.841 ± 0.020	0.056
34	6	3.730 ± 0.049	0.120

hour may be obtained by dividing the total amount consumed by the number of hours of light. Seibert (1949) found that at temperatures of 34°, 22°, and −13° C. English Sparrows consistently consumed more energy per hour on the shorter photoperiod. In the present investigation similar results were obtained (Table 4). Seibert's studies also indicated that at −13° C. the increased hourly rate was sufficient to enable the bird to eat only 2.6 per cent less on a 10-hour than on a 15-hour photoperiod.

C. *Excretory energy.*—Bird excrement consists of undigested food, digested but unabsorbed food, plus nitrogenous wastes from the kidneys. Ninety-two caloric tests were run on the feces (Table 5), two tests being made on the fecal collection of an individual bird to check for accuracy; thus, forty-six birds are represented in these tests. As a further check on accuracy, five duplicate samples (10 tests) were measured by a professional calorimetrist, his results differing from the author's by an average of only 0.07 per cent.

The maximum range between fecal values for individual birds was 0.639 Calories, or 3.966 to 3.327; the maximum range between individual temperature groups was 0.454 Calories, or 3.893 to 3.439. If the customary allowance of 3.8 per cent is made for mechanical inaccuracies attributable to the calorimeter, there are no significant differences in the caloric values of a gram of feces at any temperature or photoperiod. There is no evidence of a direct relationship between temperature and the per gram fecal energy content.

When excretory energy values for 10- and 15-hour photoperiods are combined and plotted against temperature, the linear regression slope obtained changes at the rate of 0.0964 Calories per bird per day

TABLE 6

CALORIES LOST IN FECES PER BIRD PER DAY UNDER CONSTANT TEMPERATURE CONDITIONS

Temperature (°C)	*Number of birds*	*Average excretory energy*	*Standard deviation*	*Digestive coefficient*
		10-hour photoperiod		
0	6	8.4 ± 0.58	1.41	74.8
4	4	7.0 ± 0.79	1.58	77.0
10	4	6.0 ± 0.60	1.21	80.1
18	5	3.6 ± 0.37	0.82	83.9
26	7	3.6 ± 0.32	0.86	80.9
34	7	3.8 ± 0.50	1.33	78.3
		15-hour photoperiod		
0	6	5.0 ± 0.43	1.05	82.9
10	7	4.5 ± 0.48	1.27	84.8
18	8	2.9 ± 0.25	0.70	88.4
26	10	4.9 ± 0.26	0.81	73.9
34	6	4.0 ± 0.27	0.66	79.6

TABLE 7

CALORIES LOST IN FECES PER BIRD PER HOUR UNDER CONSTANT TEMPERATURE CONDITIONS

Temperature (°C)	*10-hour photoperiod*	*15-hour photoperiod*	*Per cent difference*
0	0.84	0.33	60.7
4	0.70	—	—
10	0.60	0.30	50.0
18	0.36	0.19	47.2
26	0.36	0.33	8.3
34	0.38	0.27	29.0

per degree C. On a per-gram-bird basis this is equal to a change of 0.004 Calories (Figure 1). A graphical comparison of the daily excrement production as given in Table 6 is made in Figure 2. A broken line best fits the points for the 10-hour photoperiod (Brandt, 1950). Analysis of the data for the 15-hour photoperiod group by routine orthogonal polynomial analysis is not feasible because unequal size groups are involved. Therefore, the points on the graph for the latter group have been connected by a curved line. The two lines for excretory energy diverge at 10° C. and below, which may be the accumulative effects of slightly greater bulk of food consumed and lower efficiency of digestion.

Repeated observations showed that the voiding of excrement essentially ceases shortly after dark and does not begin again until after the bird has resumed feeding in the morning; the bulk of the excrement is thus voided during the daylight hours. To derive the calories of excrement lost per hour, the total caloric value of the ex-

crement voided was divided by the daylight hours to which the birds were exposed. Seibert (1949) found that at temperatures of 34°, 22°, and −13° C. English Sparrows voided more per hour on a 10-hour than on a 15-hour day. This would be anticipated in view of the fact that the birds ate more per hour. In the present study similar results were obtained (Table 7). At 26° C. a difference of only 8.3 per cent is evident, whereas the average for all other temperatures is 46.7 per cent.

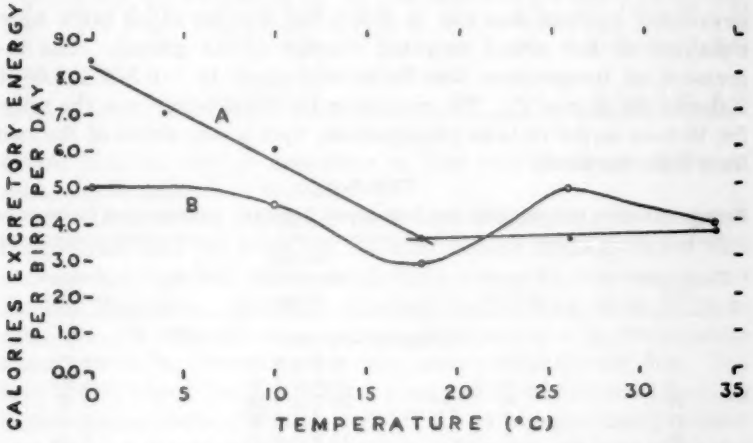

FIGURE 2. Calories lost in feces per bird per day on 10- versus 15-hour photoperiods.

The efficiency with which food is utilized as energy is affected by the type of food consumed, its protein content, and its balance of essential elements and vitamins (Hamilton, 1939). The food which English Sparrows normally consume in nature (Kalmbach, 1940) in many respects is similar to the diet used in these experiments. Therefore, it would be expected that the utilization of the two diets would be similar.

The efficiency of digestion (digestive coefficient) appears to be greatest at 18° C., a moderate temperature, and to become progressively less in either direction from this midpoint. The average out-of-doors temperature for Champaign-Urbana between May and October, the months during which this experiment was conducted, is 19.4° C. Probably the highest digestive coefficient came at 18° C. because this approximated the temperature to which the birds were normally adapted. Digestive efficiency is proportionately greater

on the 15-hour photoperiod, since, for the digestion of a given volume of food, the nutritive processes may work more leisurely.

One would expect some energy utilization by bacteria in the alimentary tract, but to date, little progress has been made in the quantitative measurement of this energy. One may assume that it would be no different in the experimental birds than it is in wild birds under natural conditions.

D. *Metabolized energy.*—For determining the relationship between calories of metabolized energy per bird and temperature (Table 8), a covariance analysis was run in which the weights of all birds were equalized to the actual weighted average (25.15 grams). The regression on temperature was linear and equal to -0.346 ± 0.0474 Calories per degree C. The regression on temperature was the same for 10-hour as for 15-hour photoperiods, that is, the slopes of the two lines were the same.

TABLE 8

ENERGY METABOLIZED PER BIRD PER DAY UNDER CONSTANT TEMPERATURE CONDITIONS

Temperature (°C)	*Number of birds*	*Average metabolized energy*	*Standard deviation*
		10-hour photoperiod	
0	6	24.9 ± 0.72	1.77
4	4	23.4 ± 1.00	1.99
10	4	24.2 ± 1.04	2.07
18	5	18.7 ± 0.64	1.43
26	7	15.2 ± 0.57	1.52
34	7	13.7 ± 1.01	2.70
		15-hour photoperiod	
0	6	24.3 ± 0.79	1.93
10	7	25.1 ± 0.75	1.98
18	8	22.2 ± 1.29	3.67
26	10	13.8 ± 1.26	4.01
34	6	16.4 ± 1.19	2.92

It is interesting, however, to note that the value of metabolized energy at the mean temperature, 17.7° C., adjusted by covariance analysis, was 19.59 ± 0.554 Calories, while the unadjusted metabolized energy at the same temperature, computed from the regression slope drawn from the raw statistics, was 19.65 Calories. Therefore, a simple analysis of variance is tenable and may, in view of the highly significant degree of correlation, apply to the analysis of gross energy and excretory energy.

Furthermore, ranking the metabolized energy values at the different temperatures in both photoperiods from highest to lowest is identical before and after adjustment, which, according to Snedecor

TABLE 9

EFFECTS OF MOLT ON THE METABOLIZED ENERGY VALUES OF BIRDS SUBJECTED TO CONSTANT TEMPERATURE CONDITIONS

	Before molting process began				*During process of molting*			
Temperature (°C)	*Number of birds*	*Number of bird days*	*Aver. Cal. M.E./bird per day*	*Standard deviation*	*Number of birds*	*Number of bird days*	*Aver. Cal. M.E./bird per day*	*Standard deviation*
			10-hour photoperiod					
0	4	80	24.7 ± 0.98	1.97	2	141	25.4 ± 1.30	1.84
4	2	45	23.4 ± 0.95	1.34	2	90	23.4 ± 2.25	3.18
34	5	88	15.0 ± 0.75	1.67	4	301	12.9 ± 1.32	2.63
			15-hour photoperiod					
34	5	96	16.0 ± 1.16	2.58	3	39	15.3 ± 2.99	5.18

(1946: 322), is another indication in this case of the tenability of using simple analysis of variance.

The fact that the regression coefficient of metabolized energy on temperature was the same for 10- and 15-hour birds indicates that photoperiod does not effect metabolized energy in summer-adapted English Sparrows. Although digestion in summer birds is more complete and efficient on a 15-hour photoperiod, a proportionately faster rate of food consumption may occur on the shorter day. Seibert (1949) found the metabolized energy of winter-adapted birds at higher temperatures (34°, 24°, and 22° C.) to be significantly greater on 15-hour rather than on 10-hour days. However, at lower temperatures (−13° C.) there was no significant difference between the two photoperiods. These differences in effect of photoperiod on summer and winter birds, which may be due to seasonal variations in acclimation of the birds, merit further investigation.

Observations on freshly-caught English Sparrows show that molting sometimes begins in the latter part of June and occasionally extends into early November, with most of the molt occurring between July and mid-October. Anticipating a possible correlation between molt and energy balance, records on molt were kept during the course of the investigation. They seem to indicate that cage existence retards the onset of molt and lengthens the molting period. This effect was most pronounced at the lowest temperature employed. In one bird maintained on a 10-hour photoperiod at 0° C., molt of the primaries was still only one-half completed on December 21 when the experiment terminated. It should be noted that, although records were kept on weight and molt beyond October, no attempt was made to follow changes in energy balance.

TABLE 10

COMPARISON OF METABOLIZED ENERGY VALUES OF MALE AND FEMALE ENGLISH SPARROWS AT CONSTANT TEMPERATURE CONDITIONS REGARDLESS OF PHOTOPERIOD

Temperature (°C)	*Number of birds*	*Sex*	*Aver. Cal. M.E./bird per day*	*Standard deviation*
0	6	Female	25.2 ± 0.87	2.13
	6	Male	24.0 ± 0.51	1.25
4	1	Female	24.4	
	3	Male	23.1 ± 1.32	2.30
10	5	Female	25.3 ± 1.15	2.58
	6	Male	24.4 ± 0.58	1.42
18	7	Female	21.3 ± 1.42	3.77
	6	Male	20.3 ± 1.33	3.25
26	9	Female	14.6 ± 0.91	2.72
	8	Male	14.1 ± 1.41	3.90
34	7	Female	13.5 ± 1.13	2.99
	6	Male	16.6 ± 0.87	2.14

Since most of the data were collected between late April and August and since cage life seemed to retard the onset of molt, only 11 of the 70 birds used in the experiments molted. The metabolized energy values of birds before and during molt did not differ significantly (Table 9). No attempt was made to compare metabolized energy values of post-molting conditions with molting and pre-molting conditions, since only 18 daily records on one individual out of a total of 1962 records on 70 individuals were obtained after molt was completed.

When an analysis of variance was run on the data in Table 10, the t value—2.73 for 70 individuals—showed by a wide margin no significant difference between the sexes as regards metabolized energy.

EFFECT OF FLUCTUATING TEMPERATURES

Procedure.—Experiments designed to study the effects of temperature on organisms are usually run at constant temperatures. However, in nature the environmental temperature encountered by most organisms is not constant but undergoes daily as well as seasonal fluctuations. Therefore, for comparison, experiments were run in which the birds were subjected to variable temperatures.

Sixteen birds were kept for a total of 868 bird-days out-of-doors in cages identical with those used in the constant-temperature units, supplied with the same food and water, and otherwise given similar treatment. Since the birds were exposed to normal out-of-doors fluctuations in temperature, humidity, length of day, and light intensity, they serve in some measure as controls for the experiments performed under constant conditions.

TABLE 11

SUMMARY OF DATA ON BIRDS UNDER FLUCTUATING TEMPERATURES GROUPED BY 5° CENTIGRADE INTERVALS REGARDLESS OF MONTH

					Excrement loss		*Metabolized energy*	
Interval (°C)	*Number of birds*	*Total days feeding*	*Average weight in grams*	*Food intake Cal./bird per day*	*Cal./bird per day*	*Digestive coefficient*	*Cal./bird/ day*	*Cal./gm. bird/day*
5–9	2	6	25.0	38.5	6.2	83.9	32.3	1.29
10–14	4	25	26.8	26.5	4.8	81.9	21.7	0.81
15–19	12	206	26.0	25.8	4.2	83.7	21.6	0.83
20–24	16	476	25.6	24.0	3.9	83.8	20.1	0.79
25–29	9	155	24.6	22.3	2.9	87.0	19.4	0.79

Results.—The constant-temperature experiments showed no significant difference in the metabolized energy of summer birds at 10- and 15-hour photoperiods. Consequently, no analysis was made in respect to the small natural changes in photoperiod during the summer months.

Records of temperature were obtained through the use of Friez thermographs. Since to date meteorologists have not been able to demonstrate significant statistical differences between average daily temperatures determined accurately by the use of a planimeter and averages obtained merely by averaging daily maximum and minimum temperatures, the latter simpler method was employed. The range of temperature included within the present set of experiments was from 5° to 29° C. Theoretically the proper size for class intervals when 24 units (29° to 5° C.) are involved is 5.5. Rather than work with uneven figures, five degree intervals were used—five degree temperature intervals are frequently used in meteorological work.

A. *Weight.*—The average weight of the birds at fluctuating temperatures was 25.6 grams, which is approximately that of the constant-temperature birds, 25.2 grams. From Table 11 it may be seen that, excluding the erratic 5° to 9° C. interval which represents only six bird-days, the birds at fluctuating temperatures tended to be increasingly heavier with decreasing temperatures. Baldwin and Kendeigh (1938) observed a similar relationship in wild birds, but this did not occur with caged birds under constant temperatures.

B. *Gross energy.*—Within the temperature range investigated, there was no significant difference in gross energy consumed at the various temperature intervals, except for the 5° to 9° C. interval. However, the trend was in the direction anticipated—food consumption increased slightly with decreasing temperatures. Comparisons of

food consumption at fluctuating temperatures of 25° to 29° C. versus a constant temperature of 26° C., 15° to 19° C. versus 18° C., and 10° to 14° C. versus 10° C. showed no significant differences.

C. *Excretory energy.*—Although the range of daily temperature over which the caloric value of the feces was measured was small (22° to 26° C.), the values obtained in 11 tests averaged 3.868 Calories per gram which is slightly higher than the mean for those obtained at comparable constant temperatures, 3.682 Calories. The difference, however, has no statistical significance. As in the case of birds at constant temperatures, the total daily excretory energy of the control birds increased as the temperature decreased.

Whereas the percentage of food intake lost in the excrement by the birds at constant temperatures showed considerable irregular variations, this percentage loss was relatively consistent in the control birds (Table 11). The greatest digestive efficiency was found at the temperature interval 25° to 29° C. in the controls, instead of 18° C. as in the birds at constant temperatures.

TABLE 12

METABOLIZED ENERGY OF BIRDS UNDER FLUCTUATING TEMPERATURE CONDITIONS GROUPED AT 5° CENTIGRADE INTERVALS OF AVERAGE DAILY TEMPERATURE

Class intervals	*Number of birds*	*Number of bird days*	*Average Cal. metabolizable energy/bird per day*
April 5°– 9°	2	6	32.3 Cal.
May 10°–14°	3	9	25.0
May 15°–19°	8	84	22.6
May 20°–24°	8	63	20.8
June 10°–14°	1	4	19.5
June 15°–19°	7	47	23.0
June 20°–24°	11	118	21.7
June 25°–29°	6	78	21.0
July 20°–24°	11	124	19.5
July 25°–29°	9	71	20.6
Aug. 15°–19°	5	18	19.9
Aug. 20°–24°	5	117	18.8
Aug. 25°–29°	2	6	18.6
Sep. 10°–14°	2	6	21.0
Sep. 15°–19°	3	36	20.1
Sep. 20°–24°	3	45	19.2
Oct. 10°–14°	2	6	21.0
Oct. 15°–19°	3	21	20.8
Oct. 20°–24°	2	9	19.5

D. *Metabolized energy.*—With the exception of the 5° to 9° interval, the metabolized energy per bird per day increased only slightly with drop in temperature (Table 11). When an analysis of variance is made of the metabolized energy of the controls, having them grouped

by months as well as by temperatures (see Table 12) the F tables show a highly significant difference between class intervals—the calculated F value (3.00) was greater than the table values (2.00 and 2.71) at both the 5 per cent and 1 per cent levels. However, when a similar test is run omitting the 5° to 9° interval for April, individual groups did not differ significantly from one another. Except for July, within each month a tendency for metabolized energy to decline slightly with increased temperatures is apparent. This change is in the direction anticipated.

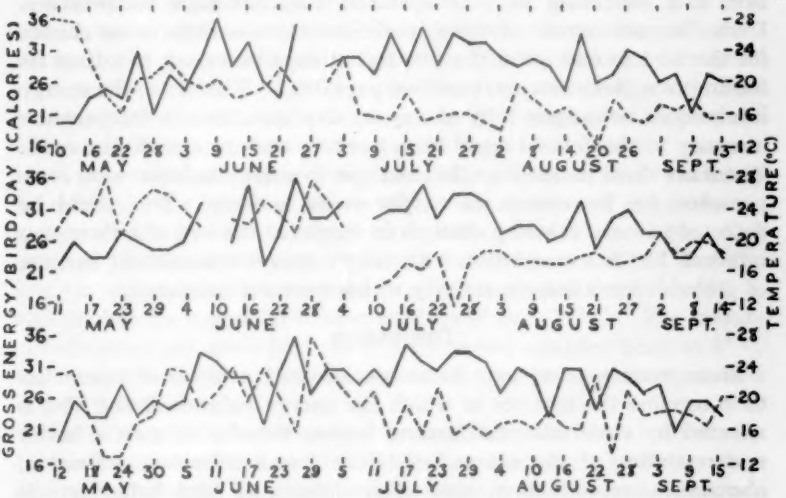

FIGURE 3. Gross energy consumption (broken lines) in relation to environmental temperature (solid lines) during 1950. Top graph, Bird 8b, male; middle graph, Bird 9b, female; bottom graph, Bird 12b, male.

In an effort to determine whether a bird utilized the same energy at the same temperature interval in different months, an analysis of variance was made for the interval 20° to 24° C. This analysis showed no significant difference between months.

Figure 1 indicates that a summer bird kept constantly at 12° C. would have a metabolized energy of about 0.85 Calories per gram bird per day. Under fluctuating temperatures, birds kept at an average range of 10° to 14° C. would require about the same amount, or 0.81 Calories (Table 11). Again referring to Figure 1, it can be seen that at a constant temperature of 27° C. a summer bird would have a metabolized energy of about 0.65 Calories per gram bird per day; while Table 11 indicates that under fluctuating temperatures,

birds kept at an average of 25° to 29° C. still require about the same amount of energy as they required at 12° C., 0.79 Calories. The constancy of food consumption in spite of changes in environmental temperature is illustrated in Figure 3 and offers an explanation for the constancy of metabolized energy. When the environmental temperature rises, the bird continues to consume approximately the same amount of food as it did at the lower temperature because of the lag in its physiological response to higher temperature. Consequently, it will have a higher metabolized energy than is characteristic of a bird held at a comparable, constant high temperature. Under fluctuating out-of-doors conditions there is little or no chance for the bird to encounter the five to ten days necessary to adjust its feeding to a given temperature (see page 388). Therefore, the energy intake does not adjust fully to day by day variations in temperature but only to the general trend from week to week or month to month. There are some indications that changes in energy balance were compensated for by change in weight or in activity. This could be detected in some cases by changes in weight at the end of a three-day interval, but the correlation with weight was not consistent because of probable variations in activity which were not measured.

DISCUSSION

Some twenty years ago Kendeigh initiated a series of researches to determine the manner in which the energy balance of the bird is affected by environmental factors, hoping thereby to gain a better understanding of the causes regulating the distribution, migration, abundance, reproduction, and other aspects of bird behavior. It was suggested that, by determining in the laboratory the effect of air temperature and photoperiod upon energy balance, it would be possible to calculate what changes may occur in this balance from month to month under natural conditions out-of-doors. Accordingly, Kendeigh (1949) performed a number of constant-temperature, constant-photoperiod experiments with English Sparrows in the winter phase of their annual cycle. This paper is concerned with the summer phase in the annual cycle of the same species.

Although a covariance analysis and a comparison of metabolized energy values before and after adjustment by covariance showed that it was not necessary to adjust for differences in weight within the narrow range of variability encountered in birds maintained at constant temperatures (see page 396), the great seasonal variability in weights of birds living out-of-doors does necessitate adjustment for differences in their weights. In the discussion which follows,

this adjustment is made by first expressing energy balance in units of per gram bird, rather than per bird. Seibert accomplished the same purpose by computing his results for each bird on the basis of per 1000 gram bird weight.

When the metabolized energy for the present series of investigations is plotted against temperature (Figure 1), the regression coefficient is 0.0138 ± 0.00188 Calories per gram bird per day per degree change of temperature. Assuming an equal precision for the two experiments—(I used 70 birds; Kendeigh, 53) the regression coefficient of winter birds, 0.0108 Calories per gram bird per day, would have a standard error of ± 0.00214. Since the difference between the two coefficients, 0.0030 ± 0.00285 Calories per gram bird per day, is only slightly more than one standard error, there is no significant difference between the two regression slopes and either of them may be used. As the regression line for summer birds runs only from 34° to 0° C., while that for winter birds continues to −31° C., the longer of the two lines has been used in correlating energy exchanges of laboratory birds with out-of-doors birds. This avoided the discrepancy which would have arisen at 0° C. had the line for summer birds been used as a reference line for 34° to 0° C. and the line for winter birds been used for 0° to −31° C. The metabolized energy per gram bird per day for winter-adapted birds at 0° C. is 0.99 Calories, while that for summer birds at the same temperature is 1.02 Calories.

Kendeigh and Seibert reasoned that confining the birds individually to small cages resulted in minimizing the expenditure of energy to a point where energy was used for little other than for the maintenance of existence. Therefore, it appeared that there would be no particular productive energy involved and that the metabolized energy in these experiments was equivalent to existence energy.

On this basis, knowing the mean monthly temperature, the existence energy in Calories per gram bird per day for English Sparrows at Champaign, Illinois, could be read directly from Figure 1. However, the computation of existence energy per bird per day may not be computed merely by multiplying Calories per gram bird per day by actual out-of-doors weight. By plotting Calories of metabolized energy per bird per day against individual bird weights at each temperature, Kendeigh (1949) determined that, for each additional gram of weight above the average of 23.8 grams, approximately 0.7 Calories of metabolized energy was required at any temperature to keep the bird in energy balance. Therefore, the effective weight of the birds would be equal to 0.7 (gram weight −23.8) + 23.8.

The following formula was used for converting Calories per gram bird per day of metabolized or existence energy into Calories per bird per day: Cal./bird/day = Cal./gm. bird/day (23.8) + 0.7 (gm. wt. −23.8). Average monthly weights for birds existing in nature were computed by combining data obtained by Baldwin and Kendeigh (1938) with those which I secured (Table 13).

TABLE 13

COMPILATION OF DATA ON WEIGHTS OF FRESHLY CAUGHT BIRDS

		Davis		**Baldwin and Kendeigh*		*Total*	
		No.	*Wt.*	*No.*	*Wt.*	*number*	*Average*
Jan.							
	Females	7	27.1	33	28.2	40	28.0
	Males	8	28.4	34	29.9	42	29.6
	Both					82	28.8
Feb.							
	Females	17	28.0	20	28.3	37	28.1
	Males	16	28.4	19	28.6	35	28.5
	Both					72	28.3
Mar.							
	Females	7	28.2	6	29.0	13	28.6
	Males	8	28.8	6	29.7	14	29.2
	Both					27	28.9
April							
	Females	18	30.0	2	30.0	20	30.0
	Males	6	28.6	1	26.5	7	28.3
	Both					27	29.2
May							
	Females	22	28.3			22	28.3
	Males	13	27.8	1	27.0	14	27.8
	Both					36	28.0
June							
	Females	20	26.5	3	28.1	23	26.7
	Males	16	27.7	4	27.2	20	27.6
	Both					43	27.2
July							
	Females	12	28.0	6	26.2	18	27.4
	Males	11	27.1	7	26.5	18	26.9
	Both					36	27.2
Aug.							
	Females	1	26.4	2	32.3	3	30.0
	Males	3	28.7	4	26.1	7	27.2
	Both					10	28.6
Sep.							
	Females			1	26.7	1	26.7
	Males			3	27.1	3	27.1
	Both					4	26.9

* Baldwin, S. P., and S. C. Kendeigh, 1938.

TABLE 13—*Continued*

COMPILATION OF DATA ON WEIGHTS OF FRESHLY CAUGHT BIRDS

	Davis		**Baldwin and Kendeigh*		*Total*	
	No.	*Wt.*	*No.*	*Wt.*	*number*	*Average*
Oct.						
Females			3	25.4	3	25.4
Males			3	27.1	3	27.1
Both					6	26.2
Nov.						
Females	4	27.8			4	27.8
Males	12	27.6			12	27.6
Both					16	27.7
Dec.						
Females	7	27.6	1	26.7	8	27.6
Males	5	29.4	7	28.4	12	28.8
Both					20	28.2
Summary						
Females	115	28.0	77	27.8	192	27.9
Males	98	28.5	89	28.7	187	28.6
Both	213	28.2	166	28.2	379	28.2

* Baldwin, S. P., and S. C. Kendeigh, 1938.

TABLE 14

VARIATIONS IN MONTHLY ENVIRONMENTAL CONDITIONS AND ENERGY BALANCE OF ENGLISH SPARROWS AT CHAMPAIGN, ILLINOIS

	Mean temp. (°C)	*Actual average bird wt., in grams*	*Effective bird weight, in grams*	*Maximum potential metabolized energy*		*Existence energy*		*Productive energy Cal./bird per day*
				Cal./gm. bird per day	*Cal./bird per day*	*Cal. per gm. bird per day*	*Cal. per bird per day*	
Jan.	−2.9	28.8	27.3	1.31	35.76	1.019	27.82	7.94
Feb.	−1.9	28.3	27.0	1.26	34.02	1.006	27.16	6.86
Mar.	4.3	28.9	27.4	1.20	32.88	0.940	25.76	7.12
April	10.5	29.2	27.6	1.15	31.74	0.872	24.07	7.67
May	16.3	28.0	26.7	1.10	29.37	0.810	21.63	7.74
June	21.6	27.2	26.2	1.04	27.25	0.752	19.70	7.55
July	24.0	27.2	26.2	0.99	25.94	0.727	19.05	6.89
Aug.	23.0	28.6	27.2	1.04	28.29	0.738	20.07	8.22
Sep.	19.0	26.9	26.0	1.10	28.60	0.780	20.28	8.32
Oct.	12.3	26.2	25.5	1.15	29.32	0.853	21.75	7.57
Nov.	4.9	27.7	26.5	1.20	31.80	0.933	24.72	7.08
Dec.	−1.0	28.2	26.9	1.26	33.89	0.998	26.85	7.04

The maximum metabolized energy per gram bird per day obtained for winter birds at −31° C. is 1.31 Calories, while for summer birds at 0° C. it is 0.99 Calories, a difference of 0.32 Calories. There appears to be no evidence that would indicate a sharp break in the

maximum potential amounts of metabolized energy available per gram bird per day in summer as compared with winter. So in preparing this column in Table 14 the difference of 0.32 Calories between these maxima was distributed evenly among the intervening months, 0.053 Calories being added accumulatively each month in either direction from the 0.99 Calories characteristic of July. Potential energy is computed by multiplying effective weight by the monthly maximum potential metabolized energy. Knowing the potential energy, it is then possible to compute productive energy by subtracting existence energy from the potential energy.

The data thus obtained have been plotted graphically in Figure 4, the straight lines being fitted to the observed points by the least squares method. The lines for potential and existence energy parallel one another, being lowest in the summer and highest in the winter. Existence energy is greatest in January when 78 per cent of the potential intake is used for this purpose; it is least in July, 73 per cent of the potential intake being used at that time. Graphically there is a difference of about 9.3 Calories of metabolized energy per bird per day between the minimum summer and maximum winter existence requirements; on the basis of actual statistics, this difference is 8.77. If the birds were actually at existence energy, this difference would represent the additional amount of energy required to enable the bird to be a permanent resident.

Although Kendeigh (1949) realized that the number 1.31 for maximum metabolized energy for winter birds might not also be applicable to summer birds, he used it tentatively for preparing curves similar to those in Figure 4. While Kendeigh's graph indicated a drop in existence energy and rise in productive energy during the warm, summer months and an increase in existence energy requirements, accompanied by decreased productive energy during the cold, winter months, the graph plotted from a compilation of Kendeigh's data with data obtained in the present investigation has a curve for existence energy similar to Kendeigh's but has a flat line representing productive energy. Such a flat line suggests that the productive energy of non-migratory birds is constant throughout the year. Apparently energy-demanding activities are spaced so as to make the best use of this energy at different times.

Experiments performed by Baldwin and Kendeigh (1932), Kendeigh (1939), and Scholander *et al.* (1950) indicate the value of feathers as heat insulators. Since the more heavily feathered winter birds had to absorb as much food as the summer-adapted birds to maintain homeostasis at the same environmental temperature—their metabo-

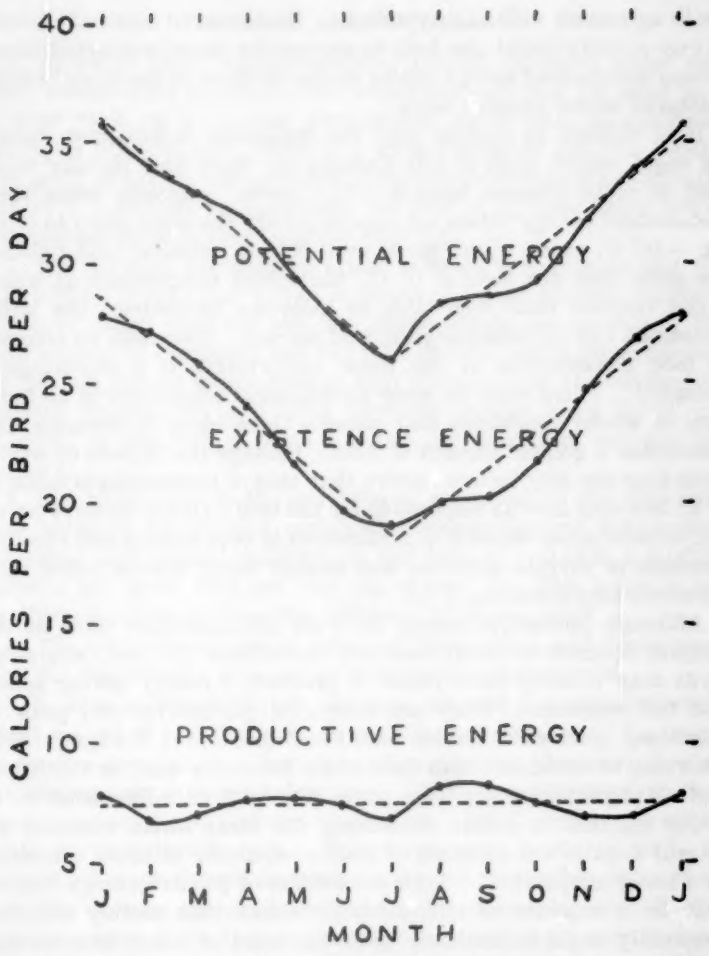

FIGURE 4. Variations in the energy balance of English Sparrows throughout the year at Champaign, Illinois. Broken lines represent regression slopes derived by the least squares method.

lized energies were the same—it would seem that the winter-adapted birds had a higher metabolic rate and, accordingly, greater thyroid activity. Metabolic rate experiments and histological investigations by Miller (1939) on the English Sparrow and examination for cyclic changes in thyroid size by Riddle and Fisher (1925) on the pigeon

are in agreement with this hypothesis. Unmeasured seasonal changes in cage activity might also help to account for summer-adapted birds' having metabolized energy values similar to those of the more heavily feathered winter-adapted birds.

It is difficult to explain why the maximum metabolized energy for caged winter birds is 1.31 Calories per gram bird per day while that of caged summer birds is 1.02 Calories, especially when their metabolized energy values are approximately the same down to 0° C. At −31° C. caged winter birds were able to consume 1.63 Calories per gram bird per day; at 0° C., the lowest temperature at which caged summer birds were able to maintain themselves, the latter consumed 1.26 Calories per gram bird per day. Obviously an increase in food consumption at the lower temperature is a physiological necessity. There must be some physiological adaptation in acclimation to winter conditions that permits these birds to consume and metabolize a greater amount of food. Perhaps the thyroid of winter birds may not only be more active than that of summer birds down to 0° C. but may also be responsible for the bird's ability to carry on an active metabolism below 0° C., differences in both relative and absolute amounts of thyroid secretion and storage being critical below temperatures approximating 0° C.

Although productive energy for such non-migratory birds as the English Sparrow is nearly constant throughout the year, migratory birds may possibly have peaks of productive energy during spring and fall migration. They are known to become fat just prior to migrating northward (Odum and Perkinson, 1951; Wolfson, 1954). This may be associated with the onset of favorable weather conditions and a physiological lag (see pages 401–402) in adjustment to it. Being adapted to colder conditions, the birds would continue for several days to eat amounts of food comparable to those consumed at a lower temperature. Such a condition of positive energy balance may be a requisite to migration. The fact that nesting activities frequently begin immediately after the onset of warm weather (see Kendeigh, 1934: 348; and Nice, 1937 for review of literature) may also initially be correlated with physiological lag, continuation of the activities being dependent upon the continued positive energy balance associated with warmer weather. The lack of such positive energy balances may be of some significance in determining the ultimate limits of the range of some species of birds.

SUMMARY AND CONCLUSIONS

1. Although caged summer-adapted English Sparrows under constant temperature conditions ate proportionately less per hour on a 15-hour than on a 10-hour photoperiod, there was no significant difference between total daily food consumption in the two groups. The gross energy for the combined photoperiods increased as a straight line with decreasing temperatures, the rate of increase being 0.0167 Calories per gram bird per day per degree C.

2. No constant relationship exists between temperature and the caloric value of one gram of feces in summer-adapted English Sparrows. However, when data for the two photoperiods are combined, the total amount of excrement and the total calories lost in the excrement per day are greater at low than at high temperatures, the relationship between temperature and total excretory energy being linear and changing at the rate of 0.004 Calories per gram bird per day per degree C.

3. For birds at both 10- and 15-hour photoperiods the regression lines obtained by plotting metabolized energy against temperature are linear and equal, changing at the rate of -0.0138 ± 0.00188 Calories per gram bird per day per degree C. This value is not significantly different from that obtained for winter birds.

4. The metabolized energy values of birds before and during molt were not significantly different at comparable temperatures.

5. Summer-adapted English Sparrows attained a maximum metabolized energy of 1.02 Calories per gram bird per day at 0° C., failing to survive more than a few days on a 10-hour photoperiod when the temperature dropped below zero. This is considerably less than the maximum of 1.31 Calories reached at $-31°$ C. during the winter phase of the annual cycle. This discrepancy probably finds its basis in pituitary-thyroid interactions not yet thoroughly understood.

6. The average amount of weight lost by summer-adapted English Sparrows upon individual confinement in small cages was 11.4 per cent (3.3 grams), with females losing an average of 5.5 per cent (1.7 grams) more than males.

7. There was no significant difference in the metabolized energy values between the sexes at constant or fluctuating environmental temperatures.

8. Caged birds under fluctuating temperatures tended to become increasingly heavy with decreasing temperatures within the range investigated. This was not evident with birds held at constant temperatures but is comparable with the situation existing in nature.

9. Comparisons of the same temperature interval during different months between May and October showed no significant difference in metabolized energy values of birds maintained at fluctuating temperatures.

10. The metabolized energy values of the control birds do not vary significantly within the temperature range of 10° to 29° C., although within the same range birds maintained at constant temperatures evidenced an inverse relationship amounting to 7.0 Calories per bird per day. The constancy of food consumption in spite of changes in environmental temperature offers an explanation for the constancy of metabolized energy. When the environmental temperature rises, the bird continues to consume approximately the same amount of food as it did at lower temperatures because of the lag in its physiological response to higher temperatures. Under fluctuating, out-of-doors conditions there is little or no chance for the bird to experience the five to ten days necessary to adjust its feeding to a given temperature. Therefore, energy intake does not adjust fully to day by day variations in temperature but only to the general trend from week to week or month to month.

11. When applied to the energy balance of birds existing out-of-doors, a compilation of the data gained by studying birds maintained at constant temperatures shows the potential energy to be greatest in January (35.76 Calories per bird per day) and least in July (25.94 Calories). However, since existence energy is highest in the winter (27.82 Calories during January) and proportionately lower in the summer (19.05 Calories during July) productive energy remains essentially unchanged throughout the year in a nonmigratory bird such as the English Sparrow.

12. The constant productive energy balance throughout the year in the English Sparrow suggests that in permanent resident birds there is good adjustment throughout the year to the greater or lesser energy demands of cold, nesting activities, molting, etc. The actual initiation of nesting and molting, however, may be associated with positive energy balances acquired as a result of favorable physiological lags. Migratory and non-migratory birds may be limited in their distribution and migratory status according to their relative adaptations for moving into and out of or remaining in areas where they can build up their short peaks of energy or maintain favorable balances of productive energy.

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GENERAL NOTES

Reappearance of Newell's Shearwater in Hawaii.—In 1931, Peters (Check-list of Birds of the World, Harvard Univ. Press, Vol. 1, p. 58) considered the Newell's Shearwater extinct. The bird was described as *Puffinus newelli* but is now considered *Puffinus puffinus newelli* by Murphy (Amer. Mus. Novit. 1586: 11, 1952). The last of seven known preserved specimens in the world had been taken in the 1890's. Native Hawaiians had apparently collected adult shearwaters for food on Molokai in 1906 (Bryan, Bishop Mus., Occ. Papers, 4: 54, 1908) but found them absent in 1907. There seem to be no further records of the species, known to Hawaiians as the *Ao*, until Fisher (Condor, **53**: 31–42, 1951) reported seeing three flying at sea between Kauai and Niihau in August of 1947. David Woodside and Joseph King report having seen several dozen shearwaters in Hawaiian waters between 1951 and 1954, that, judging from their descriptions, appear to have been Newell's Shearwaters. In spite of this evidence of the continued existence of the species, it is gratifying to be able to report a recently found specimen.

At 4:00 A.M., May 22, 1954, an adult *Ao* flew into a room of a sugar refinery near Aiea, Oahu. It was given to the Honolulu Zoo where it lived for over a month, seemingly in good health, but died June 30. Its skin is now in the American Museum of Natural History and its nearly complete skeleton, in the Bishop Museum. Brief notes and measurements seem of value because the bird has probably never been observed in captivity or photographed, and is extremely rare in collections. The bird was retiring and gentle, never attempting to bite as do some shearwaters or petrels. It soon learned to take fish from its keeper or to come to its pool for fish and ate two to four dead smelt (5″ to 6″ long) every day, swallowing them headfirst. Henshaw (Auk, **17**: 246, 1900) in his original description of *Puffinus newelli*, did not have first-hand knowledge of a live specimen. He describes the color of the feet and tarsus, where not black, as light yellow, and the beak as black and light brown. It may be significant that in the recent living bird the light-colored parts of the legs and feet were grey or pinkish-grey and the beak uniformly dark slate-colored. The wingspread and length of the *Ao* have apparently never been recorded; they were 32 inches and 14 inches in the live bird. The bird weighed 11 ounces and was in good flesh. It was a female, the ovary being 3/8 inch long and the ovules about 1/32 inch, and the oviduct readily visible. The regular museum skin measurements were: exposed culmen, 31 mm.; tarsus, 45 mm.; wing (chord), 231 mm.; middle toe and claw, 51 mm.; and tail, 82 mm.

Judging from the several records of the Newell's Shearwater in recent years, one may assume that the form is still breeding, at least in small numbers, somewhere in the Hawaiian Islands. Intensive search of the mountainous cliffs as on Kauai or Maui, may well reveal its nesting burrows.—FRANK RICHARDSON, *Bernice P. Bishop Museum, Honolulu, Hawaii.*

A New Form of Corapipo from Cerro Marahuaca, Amazonas, Venezuela.—The following new race of *Corapipo gutturalis* is described on the basis of material which I collected during the course of an investigation of the birds of Cerros Marahuaca and Duida in Territorio Amazonas, Venezuela. I propose that it be known as:

Corapipo gutturalis carminae, subsp. nov.

Type: Adult female, No. 444,143, U. S. Nat. Mus., Camp Jaime Benítez, 5000 feet elevation, Cerro Marahuaca, Amazonas, Venezuela, May 18, 1950, Ventura Barnés, Jr., collector.

NEWELL'S SHEARWATER. Captive bird at the Honolulu Zoo, June, 1954. Photograph by Fran Hall.

Subspecific characters: Female similar to that of *Corapipo gutturalis gutturalis* (Linnaeus) [*Pipra gutturalis* Linnaeus, Syst. Nat., ed. 12, vol. 1, 1766, p. 340 (Cayenne).] but with the entire dorsal surface, sides, and flanks darker, duller green; throat, breast, and abdomen clearer white.

Measurements: wing 55.8, tail 27.6, culmen from base 8.9, tarsus 15.3 mm.

Geographic distribution: Known from Cerro Marahuaca, Amazonas, Venezuela; in the upper portion of the sandstone meseta.

Remarks:—An immature male was taken at the same time as the type, with the dark plumage of the adult appearing on the head and wing coverts, but otherwise like the female, is likewise characterized by dark coloration. The location marks a considerable extension of range for the species, that hitherto has been recorded from French, Dutch, and British Guiana. The new form is easily recognizable from its dark coloration. The known localities in French, Dutch, and British Guiana from which the typical form *Corapipo gutturalis* has been recorded are all located in the Tropical Zone, as far as I am aware. This new form is found in the upper limits of the Subtropics of Cerro Marahuaca where it inhabits the humid rain forests of the upper terrains. It is my belief that the drastic change of environment afforded by the upper portions of Cerro Marahuaca was the the main factor which determined the evolution of the newly discovered geographical race.

This bird is named for my wife Carmiña, who accompanied me in many of my collecting trips.

I wish to express my sincere appreciation to Dr. Alexander Wetmore for examining my specimens and for his critical comments relating to them, some of which are included in this work, and to Dr. Herbert Friedmann my sincere appreciation for his revision of my specimens from Mt. Duida and Mt. Marahuaca. VENTURA BARNÉS, JR., *Box 3293, Mayaguez, Puerto Rico.*

The Behavior of Birds Under Stress.—The study of animal behavior is one of the most primitive of human observations. Humans have been forced to study animal behavior for the procuring of food and at times for self preservation. The recorded behavior pattern dates back to antiquity, Aristotle [Thompson, D'Arcy W. (1910). The works of Aristotle 4, Historia animalium (Oxford)] wrote on the subject. More recently we have developed a most voluminous literature on the behavior of animals in their natural habitat as well as in the laboratory. The subject has been attacked by physiologists, endocrinologists, psychiatrists, and physiochemists, as well as zoologists, for the reports in this country as well as continental Europe show extensive studies in the natural habitat as well as many laboratory-controlled experiments.

The following field observation may be of interest in showing the unusual behavior of wild birds under stress. At my county place, a bird feeding station is in operation, and among the birds which visit it there is a large number of Red-wings. Fox squirrels and chipmunks also come to the feeding station. Much of the scratch feed is spread on the ground, and there is ample for all the visitors. On more than one occasion the birds and the chipmunks in particular have gotten along most harmoniously until my dog, a spaniel, was allowed out the side door of my cabin some 75 feet away. The dog sat still and did not make a dash for the birds or the chipmunks. The Red-wings under stress on the sight of the dog attacked the two chipmunks with whom they were feeding in harmony prior to the dog's appearance.

A few years ago, I visited a small island (Shoe Island) part of the Beaver Island group in Lake Michigan. The island is about 100 feet by 50 feet, about 3 feet above

the water level, and covered largely with gravel and a little grass. On this island there is a large colony of Caspian Tern (*Hydroprogne caspia*). Most of the eggs were hatched, and the young were everywhere. On the island, there were also two nests of the Herring Gull (*Larus argentatus*) with half grown young. The Herring Gull is the proverbial enemy of the Caspian Tern and is not adverse to destroying its eggs or young. Yet, these two families of different species had lived in harmony on the island. I was anxious to catch one of the young Herring Gulls to make some studies. As I approached the nest of the Herring Gull, however, two terns swooped down and thrust their bills through the heads of the Herring Gull babies causing instant death. This was performed in the presence of myself and my companion, Walter Hastings. Stress on the part of the terns caused them to attack the gulls. ALEXANDER W. BLAIN, M.D., *Detroit, Michigan.*

Evidence for Iron Staining as the Cause of Rusty Discoloration of Normally White Feathers in Anserine Birds.—A rusty color (generally a shade of orange or orange brown) of some of the feathers which are normally white is frequently found in individual Snow Geese (*Chen hyperborea*), Blue Geese (*Chen caerulescens*) and Ross's Geese (*Chen rossii*), particularly on the head, as well as in swans of various species. It is generally believed that this color is due to a deposition of iron oxides on the feathers assumed to take place when birds feed in water containing these salts in solution rather than to true feather pigmentation. I have heard the suggestion that the variable brownish color of the back of the Sandhill Crane (*Grus canadensis*) is of a similar nature resulting in this case from the birds' placing water weeds on the back. The Handbook of British Birds (Witherby *et al.*, 1943, London) states that this sort of coloration in swans is due to deposition of peroxide of iron. However, I am not aware of any evidence to substantiate this view and personally felt rather skeptical about it.

I therefore extracted some orange brown feathers from the face of a Lesser Snow Goose (*Chen hyperborea hyperborea*) in concentrated hydrochloric acid. The acid in a few minutes took on a yellow color while the feathers became decolorized. Similar acid extraction of white feathers or brown Mallard (*Anas platyrhynchos*) feathers yielded no color in solution. The acid extract of the brownish goose feathers was filtered and tested for iron by the thiocyanate and ferrocyanide tests; both of these tests proved to be positive. White feathers from the neck of the same goose similarly treated gave a positive ferrocyanide, but a negative thiocyanate test and presumably also contained some iron but in smaller amounts. Brown mallard primaries and brown secondaries of House Sparrows (*Passer domesticus*) similarly extracted gave a negative reaction for iron by both these tests.

Finally an attempt was made to produce the naturally observed orange brown discoloration artificially. Some mallard secondaries were immersed for a few days in a 3 per cent solution of ferric chloride. The white tips and edges of these feathers took on an orange brown discoloration which could not be removed by short periods of immersion in water. While the water to which birds naturally expose themselves probably does not contain ferric chloride but rather various iron salts, the discoloration probably results from the presence of ferric ions and would be identical in both cases.

These experiments therefore show that rust-colored Snow Goose feathers contain iron which is absent in Mallard and sparrow feathers and that the discoloration can be artificially reproduced by immersion in solution of a ferric salt.—E. O. HÖHN, *Department of Physiology, University of Alberta, Edmonton, Alberta, Canada.*

Flight Behavior of the Procellariiformes.—There were about fifty Fulmars (*Fulmarus glacialis*) in Black Tickle, Labrador, on October 19, 1950. Most of these birds were flying—banking and gliding somewhat erratically about the harbor in their usual fashion. Rather suddenly, however, they began a different type of flight. One after another, the Fulmars started gliding unswervingly into the wind on stiffly outstretched wings. As they dropped closer to the water, they kicked in the water with alternate strokes of the feet, as though running across the surface. After doing this for a few seconds, a bird would acquire enough added speed to rise higher in the air. It would glide a little further before again descending to the water and repeating the performance. Most of the birds did this, over and over, at no time moving their wings. I cannot say what caused this behavior to appear almost simultaneously with so many birds. There had been no noticeable change in force or direction of the wind, a brisk, steady breeze from the northwest. Although I saw many Fulmars several other times under closely comparable conditions, I did not see this behavior again.

This action is very reminiscent of the flight of petrels, whose "water-walking" is well known. Accordingly, I have searched the available literature to determine whether other birds of the order Procellariiformes might not behave similarly. From this search has emerged a pattern of flight behavior which is very nearly order-wide. Most flying birds usually keep their legs directed back under their tails and pressed close to their bodies. It is true that some water birds, such as loons, grebes, coots, and diving ducks, paddle with their feet and flap their wings strongly as they take flight from water. Once they are air-borne, however, their legs are drawn up and kept out of the air stream. The Procellariiformes, on the other hand, may run on the water for long periods and without taking flight. At such times their wings are usually held motionless. There are differences in the exact details of such behavior, to be sure. Nevertheless, these differences do not seem very great when one considers the great diversity of birds in this order, ranging from giant gliders like the albatrosses to the relatively tiny petrels with a fluttering flight. This general type of behavior is common with some species; with others it is seen infrequently.

Nichols (1946: 19) has dealt briefly with the manner of flight of the Procellariiformes. He limited himself to rating about thirty species on the basis of four factors: elevation, flapping, rigidity, and twisting. Murphy (1936: 483) has discussed the various modes of flight found with the Procellariiformes. He gave several examples of the use of feet and legs in flight but he stopped short of suggesting that this might be general for the order. In what follows, I cite Murphy's observations, as well as all other pertinent references I could find.

The order Procellariiformes has been divided (Peters, 1931: 41) into four families. These are the Diomedeidae (albatrosses), Procellariidae (shearwaters, Cape Pigeon, fulmars, whale-birds, and gadfly petrels), Hydrobatidae (storm petrels), and Pelecanoididae (diving petrels). These represent about one hundred species. In each of these families, except probably the last, we can find illustrations of the type of flight I have described.

Members of the Diomedeidae show the behavior in several forms. Thus, Richards (1909: 7), with regard to albatrosses feeding on the water, has written: "Once on the water, the wings are kept partly expanded and raised high over the back, the wind's levitation thus bearing most of the weight. Actually, the birds now *walk on the water*, paddling with the big feet quite sufficing to lift the bodies clear." This passage deals with albatrosses as a group, not with any one species. Murphy's (1914: 441) description of a Wandering Albatross (*Diomedea exulans*) concerns some-

what different behavior: "It was a curious sight when he prepared to alight under our stern, and then, changing his purpose, ran heavily along the water for a hundred yards, before his stiffly set wings could raise his large body into the air." This is, of course, a prelude to flight, not flight itself. It is perhaps significant, however, that the feet and legs were the only mode of propulsion; there was no flapping of the wings. Still another aspect of this mode of flight was described by Murphy (1914: 446) when he wrote about Black-browed and Gray-headed albatrosses as follows: "Of eight 'Mollymokes,' our constant companions, six were *Diomedea melanophrys* and two *Thalassogeron culminatus*. As usual, when they saw bait on the hooks astern, they raised their heads comically, and often wiggled their feet with a running motion, halted in the air, and assumed extremely awkward attitudes while deciding whether to descend or fly on."

Among the Procellariidae, Cape Pigeons (*Daption capensis*) show a surprising mode of locomotion. Murphy (1936: 607) describes it: "Except in the teeth of a strong wind, the Cape Pigeons run foot after foot along the water when launching into flight. Sometimes when following a ship they will keep up this hydroplane style of progression for long distances, instead of mounting into the air. By this I mean that they set their wings as gliders and, keeping the breast barely above the surface of a quiet sea, they propel themselves with rapid, alternate running strokes of the feet. In this manner I have seen them trail my baits for an hour at a time." Interestingly enough, ashore the Cape Pigeon is almost completely helpless, being quite unable to walk in a normal manner (Murphy, 1936: 607). Murphy (1914: 451) observed that Cape Pigeons occasionally wriggle their feet with running motion as they fly, apparently at some height over the water.

Fisher, in his extensive study (1952) of the Fulmar, mentions no case where this bird uses its feet and legs during flight. Anthony (1895: 102), describing Fulmars hurrying to food on the water, has written: "Those that are on the water and have drifted away hasten to the spot with wings outspread and feet pattering along on the water." My own observations of Fulmars have already been described.

Murphy (1914: 451) has described Antarctic Whale-birds (*Pachyptila desolata*) wriggling their feet in air as though running while they flew. He has written further on this species (1936: 621): "The whale-birds . . . were progressing in the manner which I have called 'hydroplaning' in the preceding general account of the Procellariiformes. The birds worked along with an odd creeping motion, resting their bodies lightly upon the surface but holding the wings just above it, the feet apparently furnishing all of the motive power. Then, as they scurried forward quite rapidly, their heads would be thrust under water and the laminated bills would scoop for food."

Murphy's observation of the Shoemaker (*Procellaria aequinoctialis*) describes behavior which is rather unusual and which may be pertinent to the present subject. He wrote (1936: 647): "When flying thus over the nesting grounds, they often tuck one foot forward among the feathers of the belly and hold the other under the tail." Perhaps this is a vestigial remnant of the foot-wriggling habit shown by other species.

Lowe (1925: 68) regarded the flight of petrels as completely different from that of shearwaters or albatrosses. As we shall see, this view is not entirely correct. Thus, Bent (1922: 68) observes: "Like petrels the shearwaters occasionally skip along the surface of the water on their feet, using their wings to balance and support them." With respect to Greater Shearwaters (*Puffinus gravis*), Bent says: "they come skimming over the waves, alight softly on the water, and with head and breast held high and wings curved up and partly spread, they advance by rapid foot strokes to their feast." Regarding the Sooty Shearwater (*Puffinus griseus*), Audubon (1835: 555) said: "Like the small Petrels, it frequently uses its feet to support itself on the

surface, without actually alighting." Anthony (1896: 224) described Black-vented Shearwaters (*Puffinus opisthomelas*): "they chased each other, half running, half flying over the water." For Audubon's Shearwater (*Puffinus lherminieri lherminieri*) we find: "On approaching a mass of weeds, they raise their wings obliquely, drop their legs and feet, run as it were on the water, and at length alight in the sea" (Audubon, 1835: 620). Loomis (1918: 124) gives the following account of the Galapagos Shearwater (*Puffinus lherminieri subalaris*): "In rising from a calm sea they extend their wings and paddle rapidly forward for about two feet when they clear the water and are fairly a-wing. When feeding in windy weather, they often alight for a moment without closing their wings. One proved himself well worthy of the name of petrel while picking up food during a brisk wind. He would poise for a moment, with wings outspread and feet just touching the water, and then dart to the windward for a few feet without flapping his wings, which apparently served the same purpose as 'the sails of a vessel when close-hauled on the wind'."

Murphy (1914: 451) observed that Atlantic Petrels (*Pterodroma incerta*), like several other species, sometimes wriggle their feet with a running motion as they fly.

With the petrels of the family Hydrobatidae we find many instances of water-walking. Indeed, according to one explanation, the term "petrel" is derived from the name of St. Peter, who once walked on water. (This derivation of the name is not accepted by everyone, however.) The flight of Wilson's Petrel (*Oceanites oceanicus*) has been described several times. Several quotations can be given to illustrate the various aspects of its behavior. Thus (Bent, 1922: 169), "As a rule the petrels pick up the food as they skim over the water either bounding with both feet together or pattering lightly over the water running or walking with alternate feet. . . . The wings are often held motionless." Murphy (1914: 440) said: "Often as they pattered along for some distance on set, slightly depressed wings, they resembled small scurrying quadrupeds more than anything else. . . . In the strong wind I noticed that the petrels in our wake always faced the wind diagonally if not directly, with extended, motionless wings, whenever they pattered on the water." Murphy later (1936: 752) wrote, "When following a vessel, they skip along the surface as they approach, giving a vigorous kick on the lee side whenever they touch the water. When they 'stand' to feed, the wings are held rigidly and they face the wind; the momentum necessary to keep them from being blown away is furnished by the webs, the legs sinking to the heel as they work backward in unison." Roberts (1940: 175) has also described the flight of the Wilson's Petrel: "The feet are dropped only when the bird stalls or approaches the water closely, and they appear to lift the bird off the surface, steadying it and helping it along. As this downward beat of the feet occurs, the webs are spread out, and the bright yellow coloration becomes visible. Wilson's Petrels do not 'walk' on the water, but rather 'patter' on it, lowering both feet simultaneously, three or four times in quick succession, between each short stretch of gliding. When they touch the water with their feet, they do not necessarily pick up food; they pause for a moment, with body sloping upwards at about 45°, wings fully extended, and head turned down, presumably searching the surface for food." From these descriptions it appears that Wilson's Petrels may use their feet either alternately or together. As to the closely related Lowe's Storm Petrel (*Oceanites gracilis galapagoensis*), Loomis (1918: 181) says, "They usually pick up their food while fluttering close to the water with their feet dipping."

Several authors have commented on the flight of the White-faced Storm Petrel (*Pelagodroma marina*). Murphy (1936: 769) says, "their long dangling legs are conspicuous during the periods of their pattering upon the water. When they flit

over the land *en route* to their nesting grounds, they just 'tip' it with their toes, and bounce along, giving the impression of being full of springs." Again, "numbers were seen flitting along close to the surface of the sea, with their long legs dangling beneath them and just touching the water" (Ogilvie-Grant, 1896: 41). "The euphonious Maori name, Takahi-kare-moana, which means 'dancing on the waves,' . . . very aptly describes the behavior of the birds on the water" (Richdale, 1943: 97). "At sea they use the feet almost as much as their wings, as they go tripping along over the billows" (Campbell and Mattingley, 1907: 190).

Nichols (quoted by Bent, 1922: 175) says of the White-bellied Storm Petrel (*Fregetta grallaria*): "A little flock gathers [about food], pattering on the water with their feet, their wings extended fluttering over their backs." Beck (quoted by Bent, 1922: 175) reported that "An interesting characteristic of this bird is the manner in which it strikes the water with one foot. In a breeze or wind it was always the leeward leg that was used, the windward one being stretched out behind. . . . When the birds flew directly into the wind either one or the other or both legs might be used." Wilson (1907: 80) says, "We saw them continually dropping to touch the water with one foot, steadying themselves while they daintily took their minute crustacean food from the surface of the water." The congeneric Black-bellied Storm Petrel (*Fregetta tropica*) behaves somewhat similarly (Alexander, 1922: 263): "It mostly kept very close over the water near the stern of the ship, rarely flapping its wings, but hopping along over the surface with its wings spread out, gaining much of its impetus from its feet, which struck the surface simultaneously, not alternately as commonly depicted in pictures of Storm-Petrels."

Macgillivray (quoted by Bent, 1922: 128) has commented on the Storm Petrel (*Hydrobates pelagicus*): "It is only when picking up their food that, with upraised wings, they hover over the spot, and pat the water with their feet; although many persons have described this as their ordinary mode of progression."

Bent (1922: 135) says of Hornby's Petrel (*Oceanodroma hornbyi*): "The flight of this petrel, like others of its genus, is light, rapid and erratic, flitting hither and thither close to the surface of the waves, often with its feet extended as if walking on the water."

The literature contains very little indication that members of the family Pelecanoididae may use their legs and feet when flying. Coues (1903: 1021) referred to this group as "Sea-runners" but did not describe behavior warranting this name. His critical survey of the family (1866: 188) does not mention either the name or the behavior. No other writer seems to have described for the Pelecanoididae flight behavior of the type considered here. Indeed it appears that Coues' use of the name "Sea-runners" referred to behavior found frequently in other orders. Thus, Waite (quoted by Murphy and Harper, 1921: 538) says of *Pelecanoides urinatrix chathamensis*: "In rising from the water they used their legs with a paddling motion, flew a short distance with a seemingly labored or erratic flight, and then dropped to the water." This is not essentially different from the behavior of grebes or diving ducks. Murphy's (1936: 771) statements are worth quoting: "The diving petrels comprise a homogeneous, monogeneric, strikingly distinct group of Procellariiformes, the members of which exhibit few characters that might indicate their relationships with other divisions of that order. . . . Short-winged, characterized by 'whirr-flight,' like that of the auklets, rather than by gliding flight, and given to diving from above the surface of the water, the Pelecanoididae have little resemblance to typical petrels."

A fundamental feature of the type of flight considered here appears to be the use of stiffly set wings as gliders. This is accompanied by kicking or running in the

water with alternate strokes of the feet. In deviations from this basic pattern, birds may flutter their wings as they kick in the water, use both feet together when kicking, or wriggle their feet in a running motion when flying high above water. This behavior is very nearly order-wide, appears infrequently with some species and commonly with others, and has variations which seem of no utility. These facts suggest that such a manner of flight may be of genetic origin. Perhaps the ancestral Procellariiformes were birds for whom flapping flight was difficult and which glided about close to the surface of the sea, propelled largely by running strokes of the feet. With evolutionary divergence of the various groups of this order, this behavior was lost more or less completely with some birds and was modified with others. Dr. Ray H. Anderson has suggested (private communication) another useful aspect of this type of flight. It may have enabled ancestral gliding birds to stay at the surface of the water for feeding regardless of irregularities of the surface. Such advantages would still be attached to this mode of locomotion, of course.

Summary

It appears that the Procellariiformes, with the probable exception of the Pelecanoididae, may use feet and legs while flying. In the most common form of this behavior, the wings are used as gliders, while the bird runs with alternate strokes of the feet along the surface of the water. With some species the wings may be flapped or both feet may be kicked simultaneously. Other forms of this general pattern are described, and possible origins of this behavior are mentioned.

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JOHN G. ERICKSON, *2515 Thomas Ave. S., Minneapolis 5, Minnesota.*

The Generic Allocation of the Green-tailed Towhee.—The Green-tailed Towhee, currently placed in the genus *Chlorura* Sclater, 1862, was originally described by Audubon (1839). The twenty-second supplement (1947) to the American Ornithologists' Union Check-List of North American birds designates the species as *Chlorura chlorura* (Audubon). The species breeds from central Oregon and south-central Montana to southern California, southeastern New Mexico, and central western Texas. In general it is a bird of the mountains or, in the Great Basin, of high plateau country. The purpose of the present paper is to present evidence to show that this species is a true *Pipilo* allied to the type species, *Pipilo erythrophthalmus*, by way of the closely related *Pipilo ocai*, the Collared Towhee, of Mexico.

Few species of North American birds have been moved about generically more than the Green-tailed Towhee. Ridgway (1901: 401–402) lists eight genera in the synonymy of the species and there have been two others in use since 1901. The species appeared most frequently in the literature under *Pipilo* prior to 1896 when Ridgway placed it in a new monotypic genus, *Oreospiza*. He proposed this separation in spite of his remarks favoring it as a *Pipilo*, which appeared in 1890 in a review of a work by Salvin and Godman. Salvin and Godman (1879–1887) had placed the species in *Embernagra*, and Ridgway correctly pointed out the line of relationship to the true towhees via the rufous-capped Mexican forms currently known as *P. ocai*.

The original use of the genus *Oreospiza* for the Green-tailed Towhee appears on page 439 of Ridgway's "Manual" (1896), and in the appendix (1896: 605) he writes as follows:

"Page 439, Pipilo chlorurus (=Oreospiza chlorura): This bird, which has been referred by different authors to the genera "*Embernagra*" (i. e. *Arremonops*) and *Atlapetes*, but which is really far more out of place in either than in *Pipilo*, I propose to make the type of a new genus, *Oreospiza*, whose characters are intermediate between, or rather a combination of, those of *Pipilo* and *Zonotrichia*."

This constitutes the original description of the genus.

Five years later Ridgway (1901: 399) wrote the following: "*Oreospiza* is inter-

mediate between *Pipilo* and *Zonotrichia*, though much nearer the former, with which it agrees in its stout feet with long claws, rounded tail, and form of bill. Its coloration, too, is not so abnormal for *Pipilo* as has been supposed, every feature of color—rufous cap, white throat, yellow carpal edge, and olive-green upper parts—being shared by some species of that genus, though by none in the same combination. The wing, however, is very different from that of *Pipilo*, being quite the same in the relative length of the primaries as that of *Zonotrichia*, that of *Z. albicollis* being even more rounded."

In the statement quoted above with reference to color features, Ridgway's remark that the rufous cap and other color characters are, "shared . . ., though by none in the same combination," is simply in error. *Pipilo ocai* combines these and other color characters also found in the Green-tailed Towhee. It thus seems that Ridgway's only remaining basis for separation is that of wing shape which, in the Green-tailed Towhee, is longer and more pointed than in *Pipilo ocai* and *P. erythrophthalmus*.

Long, pointed wings are characteristic of species which are strong flyers or which make long migratory flights. Mayr (1942: 92, 95) discusses the correlation between wing length and geographic distribution and points out that forms of cooler climates tend (1) to have longer wings and (2) to be more migratory than forms of warmer climates.

The Green-tailed Towhee is migratory, and it seems apparent that the relatively longer wing is correlated with this habit.

Further changes in the generic position of the Green-tailed Towhee, following Ridgway's description of *Oreospiza*, have been dictated solely by nomenclatural problems. In 1915 Richmond proposed the genus *Oberholseria* to replace *Oreospiza* Ridgway, 1896, because the latter was preoccupied by *Oreospiza* Keitel, 1857. The change to *Chlorura* Sclater, 1862, was effected in 1947, as noted above, since *Chlorurus* Swainson, 1839, was deemed not to preoccupy Sclater's name.

In view of the foregoing it can scarcely be argued that the basis for *Oreospiza* Ridgway is entirely beyond question. It now remains to present the evidence in favor of its inclusion with the true towhees in the genus *Pipilo*.

In two recent papers (1950; 1954) I have described the extensive hybridization which occurs in Mexico between *Pipilo erythrophthalmus* and *Pipilo ocai*. Nearly 1,500 specimens showing evidence of hybridization between these two species have been examined up to the present. The two species are strikingly different in color pattern (1950: plate 11), and *P. ocai* is approximately 30 per cent heavier in weight than *P. erythrophthalmus*. Moreover, these species show well-marked, but overlapping, ecological differences (1950: 152–153; 1954: 270–273). Their songs, although similar, are easily distinguished, but the common call notes of the two are easily confused. Their eggs are alike in color and pattern, and both build similar nests. Both are species of dense underbrush and both scratch in the leaf litter in the same manner. *P. ocai* is primarily a bird of the understory vegetation at the higher elevations where the dominant trees are conifers. *P. erythrophthalmus* occurs most abundantly in the brushy thickets at lower elevations where oaks are more frequently dominant. Hybridization occurs at some of the points where the two species come into contact.

The situation concerning the degree of relationship between *ocai* and *erythrophthalmus* is relevant here in order to establish beyond any doubt that these two are properly considered congeneric. If this be granted then it remains only to demonstrate the close relationship between *P. ocai* and the Green-tailed Towhee in order to show the latter also to be a *Pipilo*.

In color pattern the Green-tailed Towhee is far more similar to *P. ocai* than the latter is to *P. erythrophthalmus*. The Green-tailed Towhee looks like a diminutive edition of *ocai* with the breast and facial areas gray rather than black. If size alone is considered of importance it may be pointed out that one race of *P. erythrophthalmus*, the Socorro Island population, *P. e. carmani*, is smaller than the Green-tailed Towhee.

The ecological preferences of the Collared and Green-tailed towhees are extremely similar. Both occur in dense brushy vegetation, and in many parts of its range the Green-tailed occupies the shrubby undergrowth associated with conifers.

The songs of the two species are recognizably different but show a remarkably similar pattern. After becoming familiar with the song of *P. ocai* at many localities in Mexico in 1946 and 1948, I heard the song of the Green-tailed Towhee near Irwin, Bonneville County, Idaho, on July 10, 1949. The similarity in the two songs was striking. The call notes are even more alike. Both utter a mewing note which may be written, "zree" or "zew." This cat-like note is also characteristic of many races of *P. erythrophthalmus*, especially the "Spotted Towhees" of the western United States and Mexico.

In coloration and pattern of markings, the eggs of *P. erythrophthalmus*, *P. ocai*, and the Green-tailed Towhee are nearly identical. All of these species lay eggs which have a whitish ground color with reddish markings.

The evidence presented above contains many points in favor of including the Green-tailed Towhee in *Pipilo*, but there is another line of reasoning which, although negative, bears on the question. The so-called brown towhees, *Pipilo fuscus*, *rutilis*, and *aberti*, are probably not so closely allied to *P. erythrophthalmus* as is the Green-tailed Towhee. Davis (1951: 100–102) suggests that the brown towhees may be more closely related to the genus *Melozone* and not congeneric with the red-eyed towhees, *ocai* and *erythrophthalmus*. I am in agreement with Davis on this point and propose, as a first step toward the correct generic alignment of these various forms, that the Green-tailed Towhee be recognized as a true *Pipilo*. If one is to disagree with this proposal he must justify the inclusion of the brown towhees in *Pipilo* because they are without doubt less closely related to the type species, *Pipilo erythrophthalmus*, than is the Green-tailed Towhee.

The name of the Green-tailed Towhee becomes *Pipilo chlorurus* (Audubon) if this recommendation is accepted.

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CHARLES G. SIBLEY, *Department of Conservation, Cornell University, Ithaca, New York.*

A Hybrid Longspur from Saskatchewan.—When members of two populations belonging to categories of the rank of species or higher mate and produce viable offspring the resulting individuals are termed "hybrids." (Mayr, 1942: 258.) "Sympatric hybridization" is applied to examples in which an occasional hybrid is formed between two species which coexist over large areas without interbreeding (Mayr, 1942:259).

The Chestnut-collared Longspur (*Calcarius ornatus*) and the McCown's Longspur (*Calcarius mccownii*) are sympatric over most of their breeding ranges. Both nest in the prairie regions of south-central Canada and the north-central United States. They are frequently reported as summer residents at the same locality. However, the two species do exhibit different ecological preferences. In southwestern Saskatchewan, Bent (1908:30) reported Chestnut-collared Longspurs "more abundant on the more grassy prairies" and McCown's "commoner on the more barren plains." In the eastern half of Montana, Saunders (1921: 114–116) found the Chestnut-collared preferring "areas of rather long grass bordering marshy ground, or in wet hollows where the soil is alkaline" and the McCown's more abundant on "the high, dry prairie benches" where "the grass is shorter than in places inhabited by *C. ornatus*." These same differences in habitat have been emphasized by DuBois (1935) in his studies of both longspurs in Teton County, Montana. Bailey and Niedrach (1938: 244) found that in north-central Colorado, "the flat expanses were typical nesting areas of the McCown's Longspurs and the valleys of the Chestnut-collared." Although these observations indicate well-marked average differences in habitat preference each of the authorities cited also points out that both species may at times nest in the same or closely adjoining areas.

Between May 23 and June 4, 1946, one of us (Pettingill) engaged in field studies near the town of Kronau, eighteen miles southeast of Regina, Saskatchewan. The area is part of the so-called Regina Plain, a flat, treeless region mostly under cultivation except for occasional pastures and small areas along streams and roads. These uncultivated areas were covered with grass, usually quite thick and tall, and stalks of scrubby vegetation occurring in clumps or as scattered plants. Many of these areas were investigated and Chestnut-collared Longspurs established on territories were invariably found. In addition Western Meadowlarks (*Sturnella neglecta*) and Baird's Sparrows (*Ammodramus bairdi*) were present, but there were no McCown's Longspurs.

On June 4, a large uncultivated pasture of approximately 50 acres was visited. Here the grass was short and sparse and there was no scrubby growth. Five singing Chestnut-collared Longspurs in typical plumage were noted, and a specimen which proved to be a hybrid between Chestnut-collared and McCown's longspurs was collected. This bird was noted in song flight and was observed to have elements of the display of both parental species. The flight songs of typical McCown's and Chestnut-collared longspurs differ in movements and in song pattern. Both species fly gradually upward, their wings beating rapidly. From the peak of the ascent McCown's proceeds to sail downward abruptly with wings held stiffly outstretched and raised high above the back. The Chestnut-collared, after reaching the peak of the ascent, prolongs the flight by circling and undulating, finally descending with the wings beating as rapidly as before. Both species sing after the ascent, but the song of the McCown's is louder with the notes uttered more slowly. The hybrid's song flight closely resembled the McCown's in the pattern of movement during descent and in the absence of circling and undulating, but the song itself was indistinguishable from that of the Chestnut-collared.

The hybrid specimen was an adult male in breeding condition. The larger testis was nearly 8 mm. in length and 5 mm. in width. In color pattern it is clearly intermediate between the parental species.

Although similar or virtually identical in the color of plumage areas on some parts of the body, the two parental species show at least seven major points of difference. The following table summarizes these differences. In all characters the hybrid

Item	*McCown's Longspur*	*Chestnut-collared Longspur*
Occiput	Gray	White spot
Nape	Gray	Chestnut collar
Bend of wing	Rufous	Black feathers with white tips
Throat	White	Buffy
Abdomen	White	Black
Back	Grayish	Brownish
Tail pattern	Narrow black terminal band	Broad black terminal band

is phenotypically intermediate. It seems to fall so close to the midpoint of theoretically possible recombination types that it seems likely that it is an F_1 individual rather than the result of a back cross. A description of the hybrid follows:

Pileum, post-ocular stripe, and line extending down side of hind neck black; superciliary line, lores, and throat white; cheeks buffy; occiput with white spot and nape with mottled chestnut collar. Both nape and occiput showing condition intermediate between typical parental species. Back feathers brownish-buff with darker brown centers; bend of wing (median coverts) chestnut brown with black bases; underparts black on breast with black extending down flanks, abdomen and center of belly mixed white and black, and crissum white. Pattern on rectrices intermediate between the parental species. Outermost tail feather dusky on outer web 12 mm. from tip; second rectrix dusky on outer web 17 mm. from tip; third rectrix with broad dusky tip across both webs, 20 mm. wide on outer and 10 mm. wide on inner web; fourth and fifth rectrices with same pattern as third but with slightly wider band on inner webs.

In comparison, the Chestnut-collared Longspur shows wider dark tips to the white tail feathers and McCown's shows narrower ones.

The size of the bill is a point of distinction between the McCown's and Chestnut-collared longspurs. Five adult males of McCown's show a bill depth at the anterior

margin of the nostrils ranging from 7.1 to 7.6 mm. with an average of 7.32 mm. Four adult male specimens of the Chestnut-collared Longspur range from 5.0 to 5.3 mm., averaging 5.25 mm. The hybrid is intermediate with a bill depth of 6.3 mm.

The width of the bill at the anterior margin of the nostrils in McCown's (5 specimens) ranges from 5.2 to 5.5 mm., averaging 5.34, and the Chestnut-collared (4 specimens) ranges from 4.6 to 4.9 mm., averaging 4.72 mm. The hybrid is intermediate with a bill width of 5.1 mm.

It may safely be assumed that, as a general rule, forms which successfully interbreed are more closely related than those which cannot. The discovery of a hybrid between any two species should therefore always be the stimulus for the re-evaluation of the taxonomic status of the species involved. In the present instance it seems doubtfully valid to separate the members of the genus *Calcarius*, including the Chestnut-collared, Lapland (*C. lapponicus*) and Smith's (*C. pictus*) longspurs from the monotypic genus *Rhynchophanes*, in which McCown's Longspur was placed by Baird in 1858 primarily on the basis of the larger bill.

While it is true that McCown's Longspur has the largest bill of the group, it is demonstrable that it merely represents the extreme development in a graded series. The Lapland Longspur (*Calcarius lapponicus*), an undisputed member of the genus *Calcarius*, has a bill almost exactly intermediate in size between those of the Chestnut-collared and McCown's. Ten males of *C. lapponicus* have bills ranging in depth from 6.0 to 6.4 mm. (average 6.13) and a range in width from 4.8 to 5.6 mm. (average 5.08). Comparison with the figures cited previously for the other species will demonstrate the intermediate bill size of *C. lapponicus*.

In many other important characters, the two species are extremely similar. Their habitats are different in just the way that closely related species which would offer maximum mutual competition may be expected to have evolved in order to reduce the biologically disadvantageous competition. In general habits, nest structure and egg pattern they are virtually identical.

For these several reasons it is recommended that the genus *Rhynchophanes* Baird 1858 be considered a synonym of *Calcarius* Bechstein 1802.

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Charles G. Sibley, *Department of Conservation, Cornell University, Ithaca, New York, and* Olin Sewall Pettingill, Jr., *University of Michigan Biological Station, Cheboygan, Michigan.*

Cattle Egret, Marbled Godwit, Surfbird and Brown-chested Martin in Panama.—On annual visits to Panama in the past few years, I have been on the watch for Cattle Egrets (*Bubulcus ibis*), having in mind their astonishing spread over northern South America (Dugand, Lozania, **8**: 1–7, 1954) and their recent appearance in eastern North America (Peterson, Nat. Geog. Mag., **106** (2): 281–292, 1954). In the cattle country on the Pacific slope of Panama, one often sees egrets feeding near cattle, but they have always turned out to be *Casmerodius albus* or *Leucophoyx thula*. On August 14, 1954, Major Francis O. Chapelle and I visited Mindi Dairy in the Canal Zone, near the Caribbean. About two miles south of the dairy, we spotted an unmistakable Cattle Egret perched on the head of a cow wading in a pool near the Bolivar Highway between Fort Davis and Gatun. There were two of these herons, apparently immature: white, with bright orange-yellow bills and dusky-greenish legs—a plumage I had previously seen in Cattle Egrets at Cape May, New Jersey. This is the first record of *Bubulcus* for Panama, and, so far as I am aware, for Middle America. The following week, on August 21, Major Chapelle, accompanied by his wife and Private George Goldstein, found three Cattle Egrets at a dairy farm near Maria Chiquita, also on the Caribbean coast and perhaps ten miles northeast of the Canal Zone; two of these birds showed buff on their necks. On October 2 in the same year, Major Chapelle noted two immatures across the road from the place where we first observed the species, feeding in a wet pasture among some horses; on October 24, he counted four with the horses at the same locality and seven with cattle at Mindi Dairy (where there were also Snowy Egrets); and on October 30 at Mindi Dairy, he found ten with cattle in one flock and four others in a neighboring pasture. In all cases there was open water nearby. On my 1955 trip to Panama, I visited these localities on June 28 and July 9 without seeing any Cattle Egrets.

The Marbled Godwit (*Limosa fedoa*) has occasionally been collected on the Pacific coast of South America, but there are very few published records for continental Middle America other than Mexico and none from south of Honduras. On the mud-flats of Panama Bay in front of the ruins of Old Panama, I observed three, possibly four, Marbled Godwits on August 11 and two on August 19, 1954. On September 4, 1954, from one spot, Major Chapelle and I counted twelve of the godwits, conspicuous among the numerous Willets (*Catoptrophorus semipalmatus*) and Hudsonian Curlews (*Numenius phaeopus*), and he noted ten on September 11. Thomas Imhof tells me that on November 24, 1942, during his military service in the Canal Zone, he saw a bird he believed to be this species from a passing truck near Fort Clayton; but, because the circumstances were not fully satisfactory, he refrained from publishing the observation. During the spring migration in 1955, Major Chapelle writes me that at Old Panama he counted seven on April 2, at least 150 on April 6, sixty-four on April 9, fourteen on April 19, and twelve on May 20. I spent a month in Panama in 1955, and counted, five on June 15, four on June 17, twelve on June 27, and ten on June 29 all clustered on the rocky islets near the high tide mark. Although I did not note them during two July visits to the same locality, which occurred at low tide when the shorebirds are widely scattered over the extensive flats, I suspect that the Marbled Godwit summers in Panama, as do so many other northern members of the Charadriiformes (Eisenmann, Wilson Bull., **63**: 182, 1951).

In view of the extreme scarcity of records of the Surfbird (*Aphriza virgata*) from southern Middle America (Eisenmann, Auk, **65**: 605, 1948; Imhof, Auk, **67**: 256, 1950), it is well to mention that on projecting rocks at the same Old Panama flats, I saw one (possibly two) of this species on August 11 and 19, 1954. Major Chapelle

reports seeing ten on May 15, 1954, one on October 6 and 16, 1954, and two on January 22, 1955. On June 27, 1955, I found two. This species also probably summers in Panama, but as it usually feeds on the seaward side of the rocky islets, it is rarely visible to observers on the mainland.

The Brown-chested Martin (*Phaeoprogne tapera*) is one of the very few South American land birds known to migrate north of the Equator to avoid the Southern Hemisphere winter (Zimmer, Auk, **55**: 405–410, 1938). In my list of Barro Colorado Island birds (Smith. Misc. Coll., 117, no. 5: 46, 1952) its occurrence in Panama was reported on the basis of sight observations first made in 1949. Though I promptly alerted other observers of Panama birds after recognizing the species in June, 1949, specimen confirmation was not secured until my nephew, I. Robert Eisenmann, Jr., collected one on June 15, 1952. As expected, it proved to be the southern race (*fusca*), breeding from southern Brazil to Argentina, which has long been known to migrate into northern South America (Chapman, Auk, **46**: 348–357, 1929; Beebe, Zoologica, **32**: 159–160, 1947). This form usually shows a conspicuous line of brown spots down the middle of the breast below the chest-band. Other Panama specimens were collected in June, 1953, by Dr. Alexander Wetmore and my nephew. I have found hundreds of these birds every year since 1949, during visits in June and July. Then, while locally numerous, they were noted chiefly in the cleared areas of the southern (Pacific) half of the Canal Zone and the savanna areas to the east, with very few near the Caribbean coast and none in the drier open country to the west. During August, 1954, *Phaeoprogne* was much more abundant, greatly outnumbering all other swallows together. Wherever I went, from Fort San Lorenzo and Gatun (on the Caribbean) to Chepo (in the eastern part of Panama Province) and Penonomé (in the western province of Coclé), they could always be seen in the air, or crowding together by the thousands on wires as evening approached or rainy weather threatened. By September 4, when I left, their numbers were greatly reduced (presumably by emigration), though they were still common about Panama City. On a drive through the grasslands of Coclé, where less than a month before (on August 9) thousands had been in evidence, I noted but three on September 1. The common Hirundinidae were then the northern migrants, chiefly Barn Swallows (*Hirundo rustica*), accompanied by some Bank Swallows (*Riparia riparia*) and a few Cliff Swallows (*Petrochelidon pyrrhonota*). Some indication of the length of the annual sojourn of *Phaeoprogne* in the Canal Zone is afforded by the following: Dr. Wetmore tells me that he saw a few individuals during the first week of April, 1954. Major Chapelle noted about twenty-five on May 4, 1954, and several hundred by the following week. Dr. Robert Scholes observed over two hundred as late as September 17, 1950. During September and October, 1954, Major Chapelle kindly made repeated checks for me, to determine their departure from the localities on the Pacific slope of the Canal Zone where during the summer they were so abundant. As late as September 18, he noted about eighty birds; after that only a few individuals, on October 2 and 3, six birds, on October 9, a total of seven, and on October 16, his last, a single individual on the wires near the Empire Rifle range. While not yet recorded from Middle America north of Panama, examples of *Phaeoprogne*—strikingly suggesting over-sized Bank Swallows in color and pattern—may have been passed over elsewhere on the assumption that they were brown immatures of the somewhat smaller, resident, Gray-breasted Martin (*Progne chalybea*). Such oversight is understandable, because this South American bird is not described in Ridgway's "Birds of North and Middle America" (though mentioned in the generic key). Dr. Wetmore informs me that he has recently received two Panama specimens collected by R. R. Benson at Tocumen on August 21, 1931. Certainly this now

common migrant was long overlooked in Panama.—EUGENE EISENMANN, *Linnaean Society of New York, 11 Broadway, New York 4, N. Y.*

Further Notes on Korean Birds.—Throughout November 1953, I was engaged in field work in the northernmost part of Kyonggi-do Province, Korea, as a member of the U. S. Army's Field Unit of the Commission on Hemorrhagic Fever. Since my primary tasks were those of a mammalogist, the avifauna of the area was not thoroughly investigated. Fifty-three birds were collected, the majority of which were sent to the 7277th Medical Research Laboratory near Seoul. Twenty-one study specimens were prepared and are in my collection. All specimens collected and additional observations are reported in this paper.

The entire month of November was spent in the wild, abandoned hills of the Hant'an-ch'an River Valley, eight miles east of Yonch'on and five miles north of the 38th Parallel. The level valley floor and the lower slopes of the steep hills bordering the valley were at one time heavily cultivated. However, since the beginning of the Korean War, the area has been abandoned by all but the fighting forces. As a result, the fields have grown dense with grasses, brier, and shrubs, which provide excellent cover for Ring-necked Pheasants and Migratory Quail. Prior to the war there were several villages in the valley, all of which have been completely destroyed. At the present time only a few chestnut trees remain standing to mark the sites of the former villages. Among the thick weeds, lie scattered bricks, smashed water urns, or an occasional farming tool. The many steep hills are covered with dense tangles of scrub oak, vines, various shrubs, and scattered pines. This comparatively heavy vegetation, even though the trees appear dwarfed and twisted, contrasts with the bare, eroded hills around Seoul.

Transportation was unavailable so that all my work was performed on foot and all my observations were limited to an area of approximately five square miles. The observations reported here supplement those of Wolfe (Auk, 67: 433–455, 1950), Fennell (Condor, 54: 101–110, 1952), and Straw (Condor, 55: 153–154, 1953), all of which were made in areas to the south and east of mine.

I wish to express my appreciation to Dr. Yoshimaro Yamashina, Dr. Nagahisa Kuroda, and Mr. Haruo Takashima of the Yamashina Institute for Ornithology and Zoology, Tokyo, for making available to me the Institute's fine skin collection and library and for their many helpful comments. I am further indebted to Mr. C. M. Fennell who read the manuscript and made many valuable suggestions and to Dr. H. Hara of Tokyo Imperial University who identified the crop contents of the Hazel Grouse.

Accipiter gentilis. Goshawk. On November 24, while I was collecting small birds in a narrow ravine, a large, pale goshawk flushed from a pine in front of me, crossed the ravine, and dropped out of sight behind the ridge.

Accipiter nisus. Eurasian Sparrow Hawk. I observed this species four times. On November 4, a dark brown, heavily streaked immature bird flew low over my head as I worked my rodent trap-line. Early in the afternoon of November 5, one was seen soaring in tight circles high over the hill behind my tent. As I watched, a crow flew out of the pines on the hilltop toward the hawk, but quickly retreated as the *Accipiter* made a series of short dives at it. Single individuals were also observed on November 11 and 23.

Buteo buteo burmanicus. Eurasian Buzzard. During the latter half of the month this was the most common raptor in the area; however, none was observed during the first nine days afield. On November 11, I saw a lone individual soaring

high over the river. Two were seen on November 17. Thereafter, the species was observed singly or in pairs every day. A female was collected on November 25.

Circus sp. On November 8, a pair of unidentified harriers was observed soaring low over a large, grassy field about five miles east of the Hant'an-ch'an River. I was unable to approach close enough to determine the species.

Falco tinnunculus. Kestrel. This species was observed only during the first two days I was in the area. On November 2, as I stood on a hillside watching some buntings feeding in dense brush, a Kestrel suddenly flashed past, and the buntings scattered in all directions. It landed momentarily in a nearby chestnut tree, wagged its tail and then flew off down the ridge. It had approached the birds from below, remaining hidden in the dense brush until the last moment.

Tetrastes bonasia amurensis. Amur Hazel Grouse. I found this species rather common along a stream in a deep, heavily wooded ravine. It was observed on three of the four times I passed through the area. Two birds were seen on November 21, three were seen feeding together on November 22, and a single bird was observed on November 27. A female was collected on November 22; the crop was full of seeds of a sumac, *Rhus javanica*. The species was quite tame and was easily approached.

Coturnix coturnix japonica. Migratory Quail. Not uncommon in abandoned farm land. I frequently flushed single birds or pairs while working my trap-lines. A covey of five was flushed on November 28. One female was collected on November 26.

Phasianus colchicus. Ring-necked Pheasant. Pheasants were seen or heard almost every day, and despite the great number of American and United Nations hunters in the area, the species remains quite common. During my stay in the area hunters brought in a total of eight birds.

Streptopelia orientalis. Eastern Turtle Dove. Common and observed daily. Groups of three to six individuals were often seen. A single flock of 14 was also observed. Three were collected but no specimens were saved.

Picus canus. Gray-headed Woodpecker. The only two woodpeckers observed during the entire month were of this species. On November 11, a pair was observed investigating the branches of a chestnut tree standing among ruins of a village. Both birds were quite tame.

Corvus corone. Carrion Crow. Common and conspicuous throughout the area. Flocks were often seen in the abandoned rice paddies in the valley. A large flock of approximately one hundred birds roosted in the chestnut trees of a demolished village. Daily, in the early afternoon, small flocks of 10 to 15 birds were seen circling and chasing each other over and through the pines on top of one of the hills. Often the flock would suddenly swing out over the valley to renew their play over another hilltop. Three birds were collected and sent to the 7277th Research Laboratory.

Corvus levaillantii. Jungle Crow. A single wounded individual was found on 29 November and sent to the 7277th Research Laboratory. This was the only definite record I was able to make of this species although there may have been other Jungle Crows mixed in with flocks of Carrion Crows.

Pica pica. Magpie. Although magpies were observed frequently, the species was not found to be abundant as described by Austin (Bull. Mus. Comp. Zool. 101: 1–301, 1948), Wolfe, and Fennell, in areas to the south. All of my records were limited to the areas immediately surrounding ruined villages. It was usually observed singly or in pairs, although on November 11, seven were seen roosting in the same tree with 14 (Carrion) crows. Bulky stick nests were found in chestnut and ginkgo trees, always quite close to the foundation of an old house.

Garrulus glandarius brandtii. Eurasian Jay. Not uncommon in the hills in the vicinity of heavily wooded areas. Quite tame and easily approached. Jays were observed nearly every time I entered forested areas; their presence was announced by loud, raucous squawks, often before I saw them. Usually only one or two were seen; however, flocks of six were observed on November 17 and again on November 28. Two specimens were collected; one was sent to the 7277th Research Laboratory; the other, a male in my collection, was taken from a pine-covered hillside on November 17.

Suthora webbiana. Crow Tit. Common in flocks in low underbrush. Seven birds were collected, four of which were forwarded to the 7277th Research Laboratory. Tail measurements of seven individuals vary from 62 to 69 mm. There is no noticeable difference in color. Except for the variation in length of tail, they compare favorably with Dr. Yamashina's series of *fulvicauda.* Austin (*op. cit.*, pp. 187–188) writes: "As the tails wear unevenly, varying as much as a centimeter within the series, they are not a good criterion." My own experiences verify this statement. Crow Tits were observed in large, noisy flocks almost every day. On November 24, I stood on a trail, watching a flock move from the dense brush on one side to equally dense cover on the other side. It took more than two minutes for the entire flock to pass, during which time I counted a total of 68 birds. Three other flocks with more than 50 birds each were observed, but most of the groups averaged between 20 and 30 birds.

Parus major. Great Tit. Very common. Observed with flocks of Crow Tits, Rose Finches, and Rustic Buntings. Two were collected and sent to the 7277th Research Laboratory.

Parus palustris. Marsh Tit. Not uncommon, but much less common than *Parus major.* Usually observed in mixed flocks with the Great Tit, although I never saw more than three Marsh Tits in the same flock. I collected one male which in size and color compares favorably with Yamashina's series of *hellmayri.*

Microscelis amaurotis hensoni. Brown-eared Bulbul. Common in heavily wooded areas. Usually in small flocks of from three to six birds. On November 23, three were collected from a flock of eight. Always noisy and conspicuous.

Cinclus pallasii. Pallas' Dipper. On November 20, I observed a Dipper dart up a narrow stream in a deep, wooded ravine. Another was observed on a rock beside the Hant'an-ch'an River on November 28.

Turdus naumanni. Oriental Dusky Thrush. Particularly common in the dense vegetation along streams. On November 20, a single *T. n. eunomus* was collected from a flock of 14 Dusky Thrushes, the majority of which appeared to be *eunomus.* No other *eunomus* were observed during my stay; however, *T. n. naumanni* was met with daily. On November 29, a flock of 23 was seen although they were most commonly observed singly or in small flocks of three or four. In addition to the one *eunomus,* three *naumanni* were collected.

Tarsiger cyanurus. Siberian Blue-tail. On November 8, a female of this species was found dead, hanging by the neck in a fork of a small shrub—presumably the victim of a shrike. Two males were observed on November 9 in willows bordering a stream.

Phoenicurus auroreus. Daurian Redstart. Common in brushy borders near open fields. Daily, the monotonous call-note of this species could be heard throughout the entire day from the brushy hillside behind my tent. Two fighting males were observed on November 25. Their fighting continued for several minutes, broken only by short chases from one patch of vegetation to another, until I collected one of the birds.

Regulus regulus. Goldcrest. A group of four Goldcrests was observed in a grove of dwarfed pines on the top of a hillside on November 3, in company with two Great Tits.

Lanius bucephalus bucephalus. Bull-headed Shrike. Not uncommon in brushy fields or along the brushy borders of streams. Normally three or four were seen in a day afield. Two were collected and sent to the 7277th Research Laboratory.

Passer montanus dybowskii. Eurasian Tree Sparrow. Abundant around the ruins of villages but observed in no other habitat. I never saw them around the camps as might be expected. All appeared rather shy in comparison with the sparrows of the more settled areas. As I walked through the ruins of a village, sparrows dove for cover in the dense weeds that were reclaiming the ground. When flushed from their hiding place, they darted a few inches over the grass-tops to drop into another patch of weeds. Five were collected and forwarded to the 7277th Research Laboratory.

Pyrrhula pyrrhula. Bullfinch. On November 27, two Bullfinches were observed in the dense brush bordering a stream; as I approached they flew up a hillside and disappeared in the heavy vegetation. An hour later a female was collected in the same area. In size and color it agrees perfectly with winter-collected *rosacea* from Japan.

Erythrina rosea. Pallas' Rose Finch. Common in a single narrow ravine on a brushy hillside but not observed elsewhere. Because of the thickness of the vegetation it was difficult to make an accurate estimate of the numbers of the species; however, on November 20, twenty-one birds were counted during a 10-minute period in the brush along the stream. Two streaked immature males were collected.

Emberiza elegans elegans. Yellow-throated Bunting. This species was observed on only one occasion. On November 28, a flock of six was seen in a heavily wooded area near a stream; one male was collected. It was noticeably more wary and difficult to approach than either the Rustic or Meadow buntings.

Emberiza cioides. Meadow Bunting. Very common in brushy fields, along streams, and in abandoned cultivated fields, where it was outnumbered only by *E. rustica*. I was able to save only one specimen, which is indistinguishable from Dr. Yamashina's series of *weigoldi*.

Emberiza rustica rustica. Rustic Bunting. Abundant in brush, abandoned fields, and forest borders. This was easily the most common bird in the area throughout the month, and it was a poor day when I didn't count more than a hundred in the course of a few hours. Most common in the weeds and brushy tangles of abandoned fields and along the wooded borders of streams.—J. T. Moyer, *Tokyo, Japan*.

Pintails Harassing a Short-eared Owl.—Shortly after sunrise on April 11, 1954, Dr. and Mrs. Ray H. Anderson, Mr. and Mrs. Earl J. Behan, and I saw a Short-eared Owl (*Asio flammeus*) on the west side of Sand Lake Migratory Waterfowl Refuge, South Dakota. As it dropped to the ground near a small pond, seven male Pintails (*Anas acuta*) left the water. Swinging in a wide circle, they flew directly at the owl, which was again in the air, and forced it to swerve. This was repeated again and again for several minutes until owl and ducks disappeared behind a hill. Throughout this episode the ducks flew as a compact group. There was no sign that the owl had attempted to capture any ducks. At this time, of course, migration was still underway and nesting of the ducks had apparently not begun. —John G. Erickson, *2515 Thomas Ave. S., Minneapolis 5, Minnesota*.

REVIEWS

The Birds of Ireland.—P. G. Kennedy, Robert F. Ruttledge, and C. F. Scroope, assisted by G. R. Humphreys. Edinburgh, London: Oliver and Boyd. xiii + 437 pp., 11 pls. Price, 42 shillings.—The last "Birds of Ireland," by Ussher and Warren, was published in 1900 and although it contains a wealth of material which is still of great interest to ornithologists it is now out of date in many respects. This new book, by the foremost authorities, fills an important gap by presenting an up-to-date account of the status, distribution, and migrations of Irish birds. The authors have compiled these accounts in a painstaking and critical fashion, and they have taken much trouble to ensure the accuracy of their facts.

Many interesting changes in status are recorded in detail. For example, the Greater Black-backed and Herring gulls have increased greatly in recent years, while the Arctic Tern has decreased. The Whooper Swan is now much commoner than the Bewick's Swan. The Red-throated Diver and Red-necked Phalarope continue to breed in very small numbers, though the one colony of phalaropes is now dangerously small.

The distribution of all species, both on the mainland and on many of the islands of Ireland, is described. Fullest details are given for the birds which are unevenly distributed and in the case of most sea-birds all the important colonies are listed.

Present-day knowledge of migrations of birds to and from Ireland is summarized. Arrival and departure dates for migrants are listed. However, the movements of many species in this part of the British Isles are still imperfectly understood.

As is perhaps inevitable in works of this type, more space is devoted to the rarer species. When dealing with the common birds, however, the authors have added notes on such topics as clutch-size, food, nesting habits, and display. In many cases, these notes have apparently been written with an eye to filling minor gaps in the literature and most of them supplement the detailed accounts given in the "Handbook of British Birds."

There is a very short introduction and a list of Irish names of birds. The 14 photographs are of birds or breeding haunts in Ireland. Among the most interesting are those of Barnacle Geese and the famous Pied Wagtail roost in O'Connell Street, Dublin. The absence of a map is an inconvenience for the reader who is unfamiliar with the counties and place names mentioned in the text.

This book will be of special value to students of bird distribution and will be indispensable to all serious bird-watchers who visit Ireland.—Frank McKinney.

Elements of Ecology.—George L. Clarke. New York. Wiley and Sons, 534 pp. 1954. $7.50.—This new textbook follows a general trend among recent ecological works in attempting to unify plant and animal ecology. It is organized logically into three levels or approaches—individual factors of the environment, relations intra- and interspecifically, and ecosystem relations. Thus the student is carried from autecology through synecology to the ecosystem.

Following an introductory chapter which deals with the scope of ecology and basic definitions, a chapter is devoted to each of the following factors: medium, substratum, water, temperature, light, oxygen and carbon dioxide, and nutrients. Each of these subjects is rather thoroughly discussed, and, as one might expect, the majority of the examples have been selected from aquatic, especially marine, situations because of the background of the author. There is a chapter dealing with intraspecific relations (reproduction, growth curves, cycles, and space relationships), and one on interspecific relations (symbiosis, antagonism, antibiosis, and competition). Further

synecological aspects are embraced in two chapters, one on the community and the other on succession and fluctuation. The latter of these chapters is concerned with dispersal, kinds of succession, climax communities, community classification, and cyclic fluctuations. These two chapters might well have been combined. Finally, it is encouraging to find a chapter devoted to the dynamics of the ecosystem wherein the author stresses the unity of the environment-community, trophic levels, pyramids, ecosystem of the sea, and productivity.

Although the background of the author has resulted in a large number of examples from aquatic organisms, terrestrial populations and communities are not neglected. In my estimation Dr. Clarke has presented elementary, basic ecology in a logical and lucid fashion, and he has presented good illustrations. Perhaps a chapter or section on practical or applied aspects of ecology would have been useful to the beginning student.—DAVID W. JOHNSTON.

Bubo the Great Horned Owl.—John L. George and Jean George, Illustrated by Jean George. New York: E. P. Dutton and Co. 184 pp., 53 pls. 1954. $3.00.—This children's book carries a pair of Great Horned Owls through two nesting seasons and is packed with information, not only about this species, but also about the nesting, habitat and ecological relations of the other birds and mammals to be found in a typical area in southern Michigan. It is based on a good deal of sound observations and good sources. The prose style is closer to Thornton Burgess than to Tinbergen's delightful "Kleeuw," but Burgess doesn't face his readers with such difficult bits of syntax as, "The dry beech leaves rattled around him so he did not hear the tufted titmouse titter as he flew toward him from the woodlot fence row."

'Bubo' will probably find a ready sale to maiden aunts looking for birthday presents, for it is generously illustrated with wash drawings by Jean George, who has a real feeling for her medium. The illustrations show a pleasant sense of design, a lively quality and sensitive variation of textures.

Whether the young recipients will be able subsequently to wade through the text is not so sure. Packed with disjointed factual information about all the avian and mammalian species to be found in Bubo's territory, the story shatters and flies in dozens of directions. It abounds with incidents and crises, many of them unrelated and unresolved. It is a hardy reader indeed who can focus any real interest on eight new protagonists in as many short paragraphs, especially when they bear such chatty names as Eremophila, Dendrocopus, Sylvilagus and Melospiza. The young readers of my acquaintance do not readily pronounce such titles, nor understand such terms (undefined) as buteo, larvae, passerine, mustelid, or plumicorn.

The more sophisticated young readers may reject on biological grounds such passages as, "A piece of shell pulled off on one of the sticks and the egg turned. She looked at the fragment and then at her egg. Her heart beat rapidly and her breath came fast, as she realized that the owlets were dead within the shells. [She] remained with them for another week. The hatching date came and went. No owlets emerged." Others may feel by simple logic that if Black Talon *realized* her babies were dead she would be a "dope" to remain on the nest.—ABBIE L. B. WILLIAMS.

RECENT LITERATURE

EDITED BY FRANK McKINNEY

ADAMS, C. T. 1955. Comparative osteology of the night herons. Condor, **57**: 55–60.—Numerous skeletal measurements are recorded for 41 *Nycticorax nycticorax* and 19 *Nyctanassa violacea*, and these are compared statistically. The two genera differ significantly in 17 of the 47 measurements, and it is recommended that they should be retained as separate genera.—David W. Johnston.

ALDRICH, J. W., and J. H. STEENIS. 1955. Neck-banding and other color-marking; its merits and shortcomings. Journ. Wildl. Mgt., **19**: 317–318.

ALEXANDER, S. M. D. 1954. The birds of the Blasket Islands. Bird Study, **1**: 148–168.

AMADON, D., and D. R. ECKELBERRY. 1955. Observations on Mexican Birds. Condor, **57**: 65–80.

ANDERSON, F. G. 1955. Juvenile Cowbird [*Molothrus ater*] attended by Parula Warblers [*Parula americana*]. Wilson Bull., **67**: 66.

ANDREW, D. G., G. FRAZER, M. F. M. MEIKLEJOHN, H. MAYER-GROSS, R. W. T. SMITH, and C. WALKER. 1954. A Baldpate (American Wigeon) in Lanarkshire. Scot. Nat., **66**: 123.

ANONYMOUS. 1952. Miscellaneous notes. Bull. Me. Aud. Soc., **8**: 92–95.—Pine Warblers decreasing near Brunswick; Indigo Buntings increasing in Knox County.

ARMSTRONG, E. A. 1955. The adaptable Wren. Animal Kingdom, **58**: 21–24.

AUBER, L., and APPLEYARD, H. M. 1955. The structure of the feathers in *Chlorophanes* and *Iridophanes* (Coerebidae). Ibis, **97**: 252–258.—Structural blue feathers of *Chlorophanes spiza*, "*C. purpurascens*" [actually *C. spiza caerulescens* R.W.S.] and *Iridophanes pulcherrima* have similar atypical structure; this probably is due to a rigid cortex and a less resistant medulla in the barbs, the reverse of the usual condition in birds. The genera accordingly are considered closely related, confirming the best recent opinion.—R. F. Johnston.

AUBER, L., and MASON, M. V. 1955. Structurally coloured pattern marks on the inner webs of flight feathers. Ibis, **97**: 259–265.—The uncommon feature of bright structural color on the reverse surfaces of inner webs of primary feathers is due optically to morphological configurations similar to those that cause colors on the obverse surfaces of the same feathers in *Eurystomus australis* (Coraciidae), *Pionus menstruus*, and *Loriculus vernalis* (Psittacidae). Structural colors on remiges do not occur in areas subject to high mechanical stress; these remain melanized.—R. F. Johnston.

AXTELL, H. H. 1954. What constitutes adequate verification? Prothonotary, **20** (1): 29–32 (mimeo.).

AXTELL, H. H. 1955. Can a sight record be scientific? Prothonotary, **21** (2): 13–17 (mimeo.).

AXTELL, H. H. 1955. An analysis of the reasons for writing detailed verifying accounts of unusual sight records. Prothonotary, **21** (3): 21–27 (mimeo.).

AXTELL, H. H. 1955. How to write verifying accounts of unusual sight records. Prothonotary, **21** (4): 32–36 (mimeo.).—Four papers on how to be a "sight record ornithologist." "The most adequate verification is the one that most fully anticipates and answers in advance all the doubts and questions that the most skeptical and imaginative critic might raise." A sight record has scientific value when the observation is recorded in the form of a complete written account which is available for examination. Careful censorship of records to be published is possible only when such accounts are written.

BALFOUR, E. 1955. Sooty Tern (*Sterna fuscata*) in Orkney. Scot. Nat., **66**: 190.

BARNES, I. R. 1954. A new look at Bachman's Warbler. Atlantic Nat., **10**: 18–30.

BARTH, E. K. 1955. Egg-laying, incubation and hatching of the Common Gull (*Larus canus*). Ibis, **97**: 222–239.—This study was made in southern Norway. Incubation begins after the last egg is laid and lasts for about 26 days (24 d., 1 h. to 28 d., 4 h.). The temperature at the top of the eggs during the laying period varies from about 6° C. to above 30° C. Development of the embryo does not begin until it is subject to a temperature of from 25° to 30° C. Development is most rapid above 30° C., and most eggs are incubated above this temperature. 43° C. was the highest temperature recorded. It is likely that prolonged rain increases the length of incubation because it cools the nests.—R. F. Johnston.

BARTHOLOMEW, G. A., JR., and W. R. DAWSON. 1954. Temperature regulation in young pelicans, herons, and gulls. Ecol., **35**: 466–472.—In absence of parental care, body temperature of naked young Brown Pelicans (*Pelecanus occidentalis*) varied from 21.4° to 43.7° C. at different times of day, newly hatched Great Blue Herons (*Ardea herodias*) from 32.2° to 43.5° C., and downy newly hatched Western Gulls (*Larus occidentalis*) from 34.6° to 43.3° C. Brooding at night and shading of the young during the day by adults was most extensive in the sensitive pelicans and least so in the more resistant Western Gulls, showing "the importance of behavior as a supplement for physiological mechanisms in birds."

BARTLESON, F. D., JR., and O. F. JENSEN. 1955. A study of Purple Finch winter weights. Wilson Bull., **67**: 55–59, 2 figs., 1 table.—1300 winter weights of *Carpodacus purpureus* were analyzed for differences between the ages and sexes (none), for hourly changes, and for weekly variations.

BEECHER, W. J. 1955. Late-Pleistocene isolation in salt-marsh sparrows. Ecol., **36**: 23–28.—Gulf and Atlantic coast races of Seaside and Sharp-tailed sparrows were isolated from each other when melting glaciers raised the sea level and formed large bays that interrupted the continuity of the salt marsh habitat. The northern and inland races of the Sharp-tailed Sparrow could have followed marine shorelines just south of the ice front from the Atlantic.

BELLROSE, F. C. 1955. A comparison of recoveries from reward and standard bands. Journ. Wildl. Mgt., **19**: 71–75.—For every 10 Illinois-banded mallards reported shot by hunters, 15 to 20 are bagged but unreported.

BLACKFORD, J. L. 1955. Woodpecker concentration in burned forest. Condor, **57**: 28–30.—Sixty acres of a burned forest were traversed for woodpecker counts four months after the fire. Hairy, Black-backed, and Three-toed woodpeckers, and Red-shafted Flickers were recorded in rather high concentrations.—David W. Johnston.

BLACKFORD, J. L. 1955. Nesting of European Starling in western Montana. Condor, **57**: 122–123.

BLAKE, E. R. 1955. A collection of Colombian game birds. Fieldiana: Zool., **37**: 9–23.—Distributional and taxonomic notes on 29 forms.

BOURNE, W. R. P. 1955. Migration seen in the Pyrenees in August and September. Ibis, **97**: 306–310.

BROWN, L. H. 1955. Supplementary notes on the biology of the large birds of prey of the Embu District, Kenya Colony. Ibis, **97**: 38–64; 183–221.—Population fluctuations and general breeding biology are described for *Sagittarius serpentarius*, *Aquila wahlbergi*, *A. verreauxi*, *Hieraaëtus ayresi*, *H. spilogaster*, *Terathopius ecaudatus*, *Polemaëtus bellicosus*, *Stephanoaëtus coronatus*, *Lophaëtus occipitalis*, *Circaëtus cinereus*, and *C. pectoralis*.—R. F. Johnston.

BUSS, I. O., and E. S. DZIEDZIC. 1955. Relation of cultivation to the disappearance of the Columbian Sharp-tailed Grouse from southeastern Washington. Condor, **57**: 185–187.—Historical records show a correlation between increased cultivation and decline of *Pedioecetes phasianellus columbianus* since about 1860. The decade of greatest decline was 1910–1920 at a time when about 80 per cent of the original virgin prairie was being farmed. Thus, destruction of the Sharp-tail's habitat is believed to be the most important factor in the virtually complete extirpation of a once-abundant game bird.—David W. Johnston.

CADE, T. J. 1955. Experiments on winter territoriality of the American Kestrel, *Falco sparverius*. Wilson Bull., **67**: 5–17, 1 fig., 2 tables.—Winter territoriality was studied by experiments using captive birds and dummies as "intruders." Males were less aggressive. Movement and calls by the "intruder" stimulated attack by the territorial falcon.

CADE, T. J. 1955. Records of the Black Brant in the Yukon Basin and the question of a spring route. Journ. Wildl. Mgt., **19**: 321–324.—*Branta nigricans* regularly migrates through the Basin in large numbers about the middle of May.

CAMPBELL, B. 1954. The breeding distribution and habitats of the Pied Flycatcher (*Muscicapa hypoleuca*) in Britain. Bird Study, **1**: 81–101.

CAPILDEO, R. and J. B. S. HALDANE. 1954. The mathematics of bird population growth and decline. Journ. Animal Ecol., **23**: 216–223.

CLARK, J. A. 1954. Another Marsh Harrier in Aberdeenshire. Scot. Nat., **66**: 123–124

COOCH, G. 1955. Modifications in mass goose trapping technique. Journ. Wildl. Mgt., **19**: 315–316.—Herding by age groups recommended.

COOCH, G. 1955. Spring record of Ross Goose from James Bay, Ontario. Condor, **57**: 191.

COULTER, M. W. 1955. Spring food habits of surface-feeding ducks in Maine. Journ. Wildl. Mgt., **19**: 263–267.—Study of stomachs of 39 *Aix sponsa*, 20 *Anas rubripes*, 12 *A. carolinensis*, and 1 *A. discors*. Sedges and bur-reeds had been taken in large quantities.

CRISSEY, W. F. 1955. The use of banding data in determining waterfowl migration and abundance. Journ. Wildl. Mgt., **19**: 75–84.—Suggestions for determining the relative volume of movement and the fraction of the population taken by hunters. Between one-half and two-thirds of bands recovered by sportsmen are never reported.

CRUICKSHANK, A. D. 1952. Lincoln County notes. Bull. Me. Aud. Soc., **8**: 88–90.—Highlights of the summer of 1952 at the Audubon Camp of Maine.

CRUICKSHANK, A. D. 1952. Little Green Island. Bull. Me Aud. Soc., **8**: 90.—Nesting Leach's Petrel population down to about 24 pairs. Laughing Gulls again nested successfully.

DAVIS, D. E. 1955. Determinate laying in Barn Swallows and Black-billed Magpies. Condor, **57**: 81–87.—The author states (p. 85) that "a species may be considered an indeterminate layer if the addition of eggs to the nest at the start of laying results in a reduction of clutch size and if the daily removal of eggs results in an increase." By this definition, the Barn Swallow and Magpie were found to be determinate layers since neither the addition of eggs or removal of eggs resulted in a significantly different clutch size. A search of the literature indicates that only a few species *may* be indeterminate—*Colaptes auratus, Jynx torquilla, Passer domesticus, Pygoscelis papua*, and the domestic fowl.—David W. Johnston.

DAVIS, J., and B. S. DAVIS. 1954. The annual gonad and thyroid cycles of the English Sparrow in Southern California. Condor, **56**: 328–345.—Males came into breeding condition in mid-February, but females not until mid-March. Thyroid activity was highest prior to molting in August. Comparing the gonad cycles at Pasadena with those of birds at Norman, Okla., and Minneapolis-St. Paul, Minn., the authors determined a correlation between winter temperatures and the onset of breeding at the three localities. The time of breeding at Pasadena was determined by the ovarian rather than the testis cycle.—David W. Johnston.

DEIGNAN, H. G. Remarks on *Picus vittatus* and some of its allies. Ibis, **97**: 18–24.—*P. v. eurous* (Khao Sa Bap, Chanthaburi Prov., Thailand), new subspecies.—R. F. Johnston.

DEKEYSER, P. L. 1951. Mission A. Villiers au Togo et au Dahomey (1950), iii, Oiseaux. Études Dahoméennes, v, pp. 47–90.—An annotated catalog of some 115 kinds of birds collected in these two west African countries, with a brief summary of their ecological distribution.

DEL TORO, M. A. 1954. Notes on the occurrence of birds in Chiapas, Mexico. Condor, **56**: 365.—Ten species are discussed.

DEL TORO, M. A. 1955. Frigate Birds crossing the Isthmus of Tehuantepec. Condor, **57**: 62.

DICKERMAN, R. W. 1955. Some recent Arizona bird records. Condor, **57**: 120–121.—Sixteen species are mentioned.

DOVE, R. S., and GOODHART, H. J. 1955. Field observations from the colony of Hong Kong. Ibis, **97**: 311–340.—Annotated list.

EDWARDS, E. P., and P B. LEA. 1955. Birds of the Monserrate Area, Chiapas, Mexico. Condor, **57**: 31–54.—For an area of 6 × 10 miles, there are presented descriptions of three ecological zones and the characteristic avifauna, incidental notes on associated vertebrate fauna, and an annotated list of 155 species which were collected and 29 others which were observed.—David W. Johnston.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 1–24.—Tufted Duck at Newburyport; Florida Gallinule at Saybrook, Conn.; numbers of many "stragglers" were up as a result of several years of mild winters. 181 spp. are listed for January.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 25–48.—Tufted Ducks (2) still present. Orange-crowned Warbler wintered successfully in East Hadley, Mass. Noticeable migration began in last ten days of the month. 171 spp. are listed for February.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 49–68.—Snow Geese in 16 localities, including about 1000 birds at Newburyport; Tufted Ducks still present; a Dowitcher at Springfield, Mass.; and a "spotty" duck migration are highlights of the 158 spp. listed for March.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 69–100.—Rarities include Brown Pelican and Glossy Ibis in Rhode Island; Cattle Egret at Newbury, Mass.; Bewick's Wren at Monroe, N. H., and Hooded Warbler at Criehaven, Me. Migration was early. 234 spp. are listed for April.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 101–140.—American Egret nested in South Hanson, Mass.; Swainson's Hawk seen at Plum Island; and Scissor-tailed Flycatcher in Brunswick, Me., are among the 261 spp. listed for May.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 141–172.—Many new breeding records indicate possible range extensions in the making. 248 spp. are listed for June and July.

ELKINS, K. C., and R. P. EMERY (eds.). 1954. Records of New England birds. Mass. Aud. Soc., **10**: 173–200.—Louisiana Heron at South Hanson, Mass.; breeding of the Turkey Vulture confirmed in Tyringham, Mass.; and the many uncommon species resulting from Hurricane Carol highlight the 243 spp. listed for August.

ENG, R. L. 1955. A method for obtaining Sage Grouse age and sex ratios from wings. Journ. Wildl. Mgt., **19**: 267–272.—Age can be determined in early fall by the presence or absence of primaries retained from the juvenal plumage; sex can be determined by criteria based on the earlier molt of the males. [The findings are reported on wings collected on October 4, 1953, and will need to be re-evaluated for variation between years and between dates in a given autumn.]—J. J. Hickey.

FARNER, D. S., and L. R. MEWALDT. 1955. The natural termination of the refractory period in the White-crowned Sparrow. Condor, **57**: 112–116.—In order to find the natural end of the refractory period, different groups were exposed to 15 hours of light from September until early February. Only those which began treatment after the last two weeks of October and the first week of November showed significant responses (gain in testicular weight and spermatogenesis), thus indicating the end of the refractory period as being at the end of October or beginning of November.—David W. Johnston.

FARNER, D. S., L. R. MEWALDT, and J. R. KING. 1954. The diurnal activity patterns of caged migratory White-crowned Sparrows in late winter and spring. Journ. Comp. Physiol. Psych., **47**: 148–153.

FISHER, H. I., and D. C. GOODMAN. 1955. An apparatus for measuring kinetics in avian skulls. Wilson Bull., **67**: 18–24, 1 fig.—Description of an apparatus designed to measure reliably the degree of movement of the frontonasal hinge of a bird's skull.

FITCH, H. S., and V. R. FITCH. 1955. Observations on the Summer Tanager in northeastern Kansas. Wilson Bull., **67**: 45–54, 2 figs., 1 table.—Observations of *Piranga rubra* during the nesting season.

FOSTER, B. 1955. The Short-eared Owl at Churchill, Manitoba. Ont. Field Biol., **9**: 15–17.

FRANCIS, G. 1955. The winter birds of Strathgowan [Toronto, Ontario]—a five year summary. Ont. Field Biol., **9**: 12–13.

FRENCH, N. R. 1955. Foraging behavior and predation by Clark Nutcracker. Condor, **57**: 61–62.

GALBREATH, E. C. 1955. An avifauna from the Pleistocene of central Kansas. Wilson Bull., **67**: 62–63.—Remarks on fossils of five species which are also Recent.

GENELLY, R. E. 1955. Additional records of Emperor Goose from California. Condor, **57**: 63.

GLENNY, F. H. 1954. Arteries of the neck and thorax in the true Archaeornithes. Anat. Anz., **100**: 326–328.

GLENNY, F. H. 1954. The clavicles and dorsal carotid arteries as indices of phyletic relations and levels of avian evolution. Anat. Anz., **101**: 95–100.

GLENNY, F. H. 1954. Antarctica as a center of origin of birds. Ohio Journ. Sci., **54**: 307–314.

GOODMAN, J. D. 1954. Another record of the Painted Redstart in Southern California. Condor, **56**: 361–362.

GRABER, R. R. 1955. The Nighthawks of the Tamaulipas Coast of Mexico. Condor, **57**: 125–126.

GWYNN, A. M. 1953. The egg-laying and incubation periods of Rockhopper, Macaroni, and Gentoo penguins. Australian Nat. Antarctic Res. Exped. Rep., Ser. B, **1**: 1–29.

HAMILTON, F. D., and K. S. MACGREGOR. 1954. Grey-headed Wagtail in East Lothian. Scot. Nat., **66**: 126–127.

HAMILTON, F. D., and K. S. MACGREGOR. 1954. Lapland Buntings in East Lothian. Scot. Nat., **66**: 127–128.

HAMILTON, F. D., and K. S. MACGREGOR. 1955. Wilson's Phalarope in Scotland. Scot. Nat., **66**: 188–190.

HAMILTON, F. D., K. S. MACGREGOR, and R. F. C. ZAMBONI. 1954. Notes on the birds of Glen Moidart, Inverness-shire. Scot. Nat., **66**: 89–93.

HEBARD, F. V. 1952. A visit to Little Green Island. Bull. Me. Aud. Soc., **8**: 91.—250 pairs of Laughing Gulls nesting (increase); pair of Razor-billed Auks in courtship on Matinicus Rock; Puffin colony holding its own.

HELM, L. G. 1955. Plastic collars for marking geese. Journ. Wildl. Mgt., **19**: 316–317.—Koroseal strips overlapped and stapled at the ends lasted four to six months (one up to two years).

HERING, L. 1955. New nesting records from Boulder County, Colorado. Condor, **57**: 62.—*Psaltriparus minimus*, *Regulus satrapa*, and *Passerina cyanea* are discussed.

HICKLING, R. A. O. 1954. The wintering of gulls in Britain. Bird Study, **1**: 129–148.

HOWARD, H. 1955. New records and a new species of *Chendytes*, an extinct genus of diving geese. Condor, **57**: 135–143.—To 61 known specimens of the Pleistocene *Chendytes* are added another 82 specimens, all from various localities in southern California or from San Nicolás Island. *Chendytes milleri* is described from the San Nicolás Island material and is believed to be an earlier species than *C. lawi*.—David W. Johnston.

HOWELL, T. R. 1955. A southern hemisphere migrant in Nicaragua. Condor, **57**: 188–189.—*Atticora cyanoleuca patagonica*.

HOWLAND, L. 1955. Howland Island, its birds and rats, as observed by a certain Mr. Stetson in 1854. Pacific Sci., **9**: 95–106.—Natural history notes and observations by J. C. Greenway, Jr. are appended.

HUBBS, C. L. 1955. Black Scoters reported from Baja California. Condor, **57**: 121–122.

HUDSON, G. E., and P. J. LANZILLOTTI. 1955. Gross anatomy of the wing muscles in the family Corvidae. Amer. Midland Nat., **53**: 1–44.—"In regard to the musculature of the wing the Corvidae studied [19 species] show a remarkable uniformity."

JOHNSGARD, P. A. 1955. Courtship activities of the Anatidae in Eastern Washington. Condor, **57**: 19–27.—Courtship displays are described for the following species—*Anas platyrhynchos*, *A. acuta*, *A. carolinensis*, *A. discors*, *A. cyanoptera*, *A. streperus*, *Mareca americana*, *Spatula clypeata*, *Aythya americana*, *A. valisineria*, *A. collaris*, *A. affinis*, *Bucephala albeola*, *B. clangula*, *B. islandica*, *Oxyura jamaicensis*, and *Mergus merganser*. Some illustrations are presented.—David W. Johnston.

JOLLIE, M. 1955. New records for Idaho. Condor, **57**: 189.—*Grus c. canadensis* and *Clangula hyemalis*.

JONES, L. V. 1954. Distinctiveness of color, form, and position cues for pigeons. Journ. Comp. Physiol. Psych., **47**: 253–257.

KETTLEWELL, H. B. D. 1955. A Story of Nature's Debauch. The Entomologist, vol. 88, no. 1101, Febrnary, 1945, pp. 45–47.—Near Pretoria, Transvaal, the author found a nest of wild bees in an old rusted ruin of an automobile chassis. It was full of apparently intoxicated bees and one semi-drunk honey-guide (*Indicator indicator*). With a long-handled clamp Kettlewell extracted the bird, covered with bees. On releasing it, the bird, ". . . began to flap, and before we could catch it, it became air-borne and flew in the most crazy fashion, obviously quite drunk and incapable, but not before I had had time to take good note of it." The honey in the nest was found to be fermented and strongly alcoholic. It is suggested that the fact that the nest was within a metal container exposed to the direct rays of the sun had hastened this unusual fermentation.—H. Friedmann.

KIEL, W. H., JR. 1955. Nesting studies of the Coot in southwestern Manitoba. Journ. Wildl. Mgt., **19:** 189–198.—Nest success 97 per cent for 380 nests; in contrast to 73 per cent for over-water-nesting ducks and 50 per cent for land-nesting ducks. Mean clutch 9.9 (169 clutches). Cattail and bulrush preferred for nesting.

KIMSEY, J. B. 1955. The White-tailed Kite in Humboldt County, California. Condor, 57: 190.

KINSEY, E. C. 1955. A recent record of the Pileated Woodpecker in Marin County, California. Condor, **57:** 190–191.

KIRSHER, W. K. 1954. Willet nesting in the Central Sierra Nevada, California. Condor, **56:** 361.

KLONGLAN, E. D. 1955. Factors influencing the fall roadside pheasant census in Iowa. Journ. Wildl. Mgt., **19:** 254–262.—Numbers of *Phasianus colchicus* seen on early-morning transects from August 1 to October 31 were affected by dew, by time of day, by rain falling during or before the census, by fog, and by other weather factors.

KOZICKEY, E. L., G. O. HENDRICKSON, and P. G. HOMEYER. 1955. Weather and fall pheasant populations in Iowa. Journ. Wildl. Mgt., **19:** 136–142.—Continuous subnormal temperatures from December through February, apparently depressed the level of the subsequent fall population. A warm March and/or April had no discernible effect. A cold May and/or June were not conducive to an increase.

KURODA, N. 1955. A list of photographs or drawings of male ducks in their eclipse plumages. Annot. Zool. Jap., **28:** 48–51.

KURODA, N. 1955. The present status of the protection of birds and mammals in Japan. Proc. 7th Pac. Sci. Congr., **4:** 719–727.

LEGG, K. 1954. Nesting and feeding of the Black Oyster-catcher near Monterey, California. Condor, **56:** 359–360.

LOCKIE, J. D. 1955. The breeding and feeding of Jackdaws and Rooks with notes on Carrion Crows and other corvidae. Ibis, **97:** 341–369.—Clutch-size in *Corvus monedula* is 4.4 eggs and in *C. frugilegus* 4.3 eggs. These seem to result in the brood sizes that produce the most young. Asynchronous hatching is shown to be an adaptation to a variably abundant food supply: in a food shortage the smaller young die first, leaving the remainder in better correspondence with the food supply. The young of several corvids are shown to be in the nest when the greatest amount of food is available to them.—R. F. Johnston.

LONGSTAFF, T. G. 1954. Migration along the north-west coast of Scotland. Scot. Nat., **66:** 94–100.

LORD, D. 1955. Occurrence of the Prairie Warbler at Georgian Bay, Ontario. Ont. Field Biol., **9:** 23–24.

MACDONALD, D. 1955. Spotted Redshank in South-east Sutherland. Scot. Nat., **66:** 185.

MACKENZIE, J. M. D. 1954. Some Capercaillie notes. Scot. Nat., **66:** 124–125.

MACKENZIE, J. M. D. 1955. Redstarts reared in tits' nests. Scot. Nat., **66:** 146–154.

MARSHALL, A. J. 1955. We are beginning to understand the bower-birds. Animal Kingdom, **53:** 34–43.

MARSHALL, J. T., JR. 1955. Hibernation in captive goatsuckers. Condor, **57:** 129–134.—Two young *Chordeiles acutipennis* were kept from July to November, at the end of which time they were in a dormant state (room temp., 18.7°; oral temp., 18.6° and 19.2°) and had become fat. Three adult *Phalaenoptilus nuttallii* similarly became dormant during the winter. Lack of food and low body weight rather than low external temperature induced hibernation, although when handled the birds would become fully awake.—David W. Johnston.

MAYHEW, W. W. 1955. Spring rainfall in relation to Mallard production in the Sacramento Valley, California. Journ. Wildl. Mgt., **19:** 36–47.—Birds nested in dry as well as in wet years, but brought off broods only in latter. Since direct application of water is apparently necessary for successful hatching, the wetting of eggs by rainfall seems to affect the production of young in the central Sacramento Valley.

MAYR, E. 1955. Comments on some recent studies of song bird phylogency. Wilson Bull., **67:** 33–44.—A detailed review of the studies by H. B. Tordoff and W. J. Beecher.

MCCABE, R. A. 1955. Some data on Wisconsin pheasants obtained by interviewing farmers. Journ. Wildl. Mgt., **19:** 150–151.—Nest destruction during hay-mowing, hen mortality, clutch size, broods and birds per farm were investigated.

MCINTYRE, J. D. 1955. First record of a Double-crested Cormorant in Algonquin Park. Ont. Field. Biol., **9:** 25.

MCMILLAN, I. I. 1955. An observation of flight exhaustion in California Quail. Condor, **57:** 188.

MEIKLEJOHN, M. F. M. 1954. Shore-larks in East Lothian. Scot. Nat., **66:** 125–126.

MEIKLEJOHN, M. F. M., and C. R. PALMAR. 1954. Report on birds of the Clyde area, 1953. Scot. Nat., **66:** 65–69.

MEIKLEJOHN, M. F. M., and J. K. STANFORD. 1955. June notes on the birds of Islay. Scot. Nat., **66:** 129–145.

MEINERTZHAGEN, R. The speed and altitude of bird flight (with notes on other animals). Ibis, **97:** 81–117.—Detailed tabular presentation of selected records.—R. F. Johnston.

MELLOR, N. H. 1955. A winter-active Poor-will. Condor, **57:** 120.

MELLOR, N. H. 1955. Inca Dove and Ground Dove recorded at Corona, Riverside County, California. Condor, **57:** 191.

MICHAEL, V. C., and S. L. BECKWITH. 1955. Quail preference for seed of farm crops. Journ. Wildl. Mgt., **19:** 281–296.—In 600 feeding trials involving 53 different food items offered simultaneously to penned *Colinus virginianus*, grass seeds were preferred to legumes and annual grasses to perennial grasses. Recognized quail foods were all placed relatively low. Some selection by taste alone was thought to take place.

MILLER, A. H. 1954. Nomenclature of the Black-throated Sparrows of Chihuahua and Western Texas. Condor, **56:** 364–365.

MILLER, A. H. 1955. Record of the Least Flycatcher in Central British Columbia. Condor, **57**: 62–63.

MILLER, A. H. 1955. The avifauna of the Sierra del Carmen of Coahuila, Mexico. Condor, **57**: 154–178.—This large sierra is significantly isolated both spatially and ecologically from similar areas. It is insular in nature. Insularity in the avifauna is indicated by the absence of many conifer-zone species present in mountainous areas to the north, west and south, and by subsequent ecological relationships and extensions of species which are present. Thus, the absence of competitive species in woodpeckers, jays, parids, and warblers has permitted the existing species to expand their geographic and ecological ranges. Certain of these "insular" forms have been derived from sierras to the north, west, and south, most of them showing affinities to northern forms of west Texas. In addition to these ecological analyses, an annotated list of 112 species is presented.—David W. Johnston.

MISKIMAN, M. 1955. Meteorological and social factors in autumnal migration of ducks. Condor, **57**: 179–184.—A study of migrant Black Ducks, Mallards, and Lesser Scaups in Ohio showed that resting ducks became increasingly active with a decrease in light. Rafting ducks faced strong winds. Migrants supposedly build up in numbers during prefrontal weather and then continue to migrate when the weather clears.—David W. Johnston.

MUIR, R. C. 1954. Calling and feeding rates of fledged Tawny Owls. Bird Study, **1**: 111–117.

MUNRO, J. A. 1955. Additional observations of birds and mammals in the Vanderhoof Region, British Columbia. Amer. Midland Nat., **53**: 55–60.

MURDOCH, C. C. I. 1955. Blackcap in Inverness-shire in winter. Scot. Nat., **66**: 191.

MURPHY, R. C. 1955. Patagonian Penguins. Nat. Hist., Mar., 1955: 134–139.

NEWMAN, R. J. 1954. Toxostoma ocellatum and Diglossa baritula in Hidalgo. Condor, **56**: 361.

NICE, M. M. 1955. Blue Jay [*Cyanocitta cristata*] anting with hot chocolate and soap suds. Wilson Bull., **67**: 64.

OWEN, D. F. 1955. The food of the heron *Ardea cinerea* in the breeding season. Ibis, **97**: 276–295.—Food samples were collected from nestlings at three heronries in central England. Herons took the most available food (mainly fish) that was large enough to be easily handled. Incidence of prey species varied at different heronries seasonally and yearly due to parallel fluctuations in the number and kind of prey available. The breeding season of this bird seems timed so that when young are in the nest there is a maximum of prey available. In spite of this, many nestlings died of starvation. Asynchronous hatching of herons seems to be advantageous; in the event of a food shortage the youngest nestlings die first, enabling the remaining young to survive on the diminished food supply. In this fashion whole broods are not exposed equally to starvation, all perhaps to die.—R. F. Johnston.

PARKER, H. M., and R. P. EMERY (eds.). 1953. Records of New England birds. Mass. Aud. Soc., **9**: 157–183.—Manx Shearwater off Chatham, Mass.; Oystercatcher at Nantucket; Sabine's Gull and Bridled Terns at Monomoy. First breeding record of Ruddy Duck on Mt. Desert, Maine. Migration began early. 234 spp. are listed for August.

PARMALEE, P. W. 1955. Some factors affecting nesting success of the Bob-white Quail in east-central Texas. Amer. Midland Nat., **53**: 45–55.

PARTRIDGE, W. H. 1954. Estudio preliminar sobre una coleccion de aves de

Misiones. Rev. Inst. Nac. Invest. Cien. Nat., Zool., **3**: 87–153, 4 pls.—Annotated list of birds in a collection from Misiones, Argentina.

PASTORE, N. 1954. Spatial learning in the Canary. Journ. Comp. Physiol. Psych., **47**: 288–289.

PAYNTER, R. A., JR. 1955. Additions to the ornithogeography of the Yucatan Peninsula. Postilla, **22**, 4 pp. (unpaged).

PEARSON, O. P. 1954. The daily energy requirements of a wild Anna Hummingbird. Condor, **56**: 317–322.—The author has determined the metabolic rate and time for hovering and perching in this hummingbird's daily activities. Most of its time and energy were expended in perching and feeding. The male under observation (for two 24-hr. periods) obtained most of its food (energy) from the 1022 flowers on a single *Fuchsia* bush.—David W. Johnston.

PENNIE, I. D. 1955. Garden Warbler and Chiffchaff in Sutherland. Scot. Nat., **66**: 191.

PITELKA, F. A., P. Q. TOMICH, and G. W. TREICHEL. 1955. Ecological relations of jaegers and owls as lemming predators near Barrow, Alaska. Ecol. Mono., **25**: 85–117.—As the lemming cycle increased from a low in 1951 to a high in 1953, Pomarine Jaegers, Snowy and Short-eared owls became numerous and bred. These and other predators reduced lemming population to 1/10 or even 1/20 the number present in mid-June when they became vulnerable with the melting of snow. The main growth of the lemming population is between August and June of the next year, but the heavy predation tends to dampen the cyclic peaks and extend the interval between peaks. Factors affecting the timing and success of the breeding of these avian predators are discussed in some detail.

PITELKA, F. A., P. Q. TOMICH, and G. W. TREICHEL. 1955. Breeding behavior of jaegers and owls near Barrow, Alaska. Condor, **57**: 3–18.—During the breeding seasons of 1952 and 1953 extensive studies were made on three predators on the tundra: *Stercorarius pomarinus*, *Nyctea scandiaca*, and *Asio flammeus*. The number of nests found were 110, 10, and 28, respectively. Their breeding is dependent upon the number of brown lemmings. All three of these species show territorial behavior which in many ways resembles territoriality of passerines. Details of the nesting cycle for each species are presented.—David W. Johnston.

PORTER, R. D. 1954. Additional and new bird records for Utah. Condor, **56**: 362–364.—Fourteen species are listed.

PORTER, R. D. 1955. The Hungarian partridge in Utah. Journ. Wildl. Mgt., **19**: 93–109.—*Perdix perdix* has been introduced successfully in Utah in those regions with the largest percentages of land acreage in farms. Free water is required in desert areas. Mowing operations and severe winters are critical mortality factors. In most parts of Utah, high June and July temperatures seem to be limiting.

PRESTON, F. W. 1955. Tail winds and migration. Wilson Bull., **67**: 60–62.—Different strata of air may be simultaneously moving in different directions, and migrating birds seem to be able to select those which will give them a tail wind.

RAINEY, D. G., and T. S. ROBINSON. 1954. Food of the Long-eared Owl in Douglas County, Kansas. Trans. Kansas Acad. Sci., **57**: 206–207.

RAND, A. L. 1955. The origin of the land birds of Tristan da Cunha. Fieldiana: Zool., **37**: 139–166.—"Evidence indicates that the land avifauna of Tristan da Cunha [and Gough Island] is entirely of American origin and that the islands were colonized by accidental wanderers aided by the prevailing west winds."

RAND, A. L. 1955. A new species of thrush from Angola. Fieldiana: Zool., **34**: 327–329.—*Cossypha heinrichi*, new species.

RANDALL, R. N. 1955. Mourning Dove production in south central North Dakota. Journ. Wildl. Mgt., **19**: 157–159.—In a coulee, nesting activities reached a peak in July while the time curve of usage in a shelterbelt was much flatter; 70–77 per cent of the nests were successful. There was little evidence of preference for any species of tree or shrub in selection of nest site.

RICHARDSON, F., and D. H. WOODSIDE. 1954. Rediscovery of the nesting of the Dark-rumped Petrel in the Hawaiian Islands. Condor, **56**: 323–327.

RICHDALE, L. E. 1955. Influence of age on size of eggs in Yellow-eyed Penguins. Ibis, **97**: 266–275.—892 eggs of marked female *Megadyptes antipodes* in New Zealand were studied. Immature penguins, to 4 or 5 years of age, laid lighter and narrower eggs than did mature penguins, which are 5 to 14 years of age. Aged birds, to 19 years, laid lighter and more variably-shaped eggs.—R. F. Johnston.

RIDGELY, B. S. 1952. Atlantic Murre at Machias Seal Island. Bull. Me. Aud. Soc. **8**: 87–88.—On June 23, 1952.

RIPLEY, S. D. 1954. Comments on the biogeography of Arabia with particular reference to birds. Journ. Bombay Nat. Hist. Soc., **52**: 241–248.

RIPLEY, S. D., and D. S. RABOR. 1955. A new fruit pigeon from the Philippines. Postilla, **21**: 2 pp. (unpaged).—*Ptilinopus arcanus*, new species.

ROOT, O. M. 1952. Franklin County bird notes. Bull. Me. Aud. Soc., **8**: 85–87.—Brown Thrasher and Field Sparrow seen north of records listed by Palmer; also notes on other summering spp.

ROSCOE, E. J. 1955. Aquatic snails found attached to feathers of White-faced Glossy Ibis [*Plegadis mexicana*]. Wilson Bull., **67**: 66.—An important method of dispersal for some mollusks.

RUDD, R. L., and R. E. GENELLY. 1955. Avian mortality from DDT in Californian rice fields. Condor, **57**: 117–118.—DDT-treated rice was experimentally fed to a number of Ring-necked Pheasants and Pintail Ducks. In both species some individuals began to resist the diet but others died. These experiments are correlated with numerous field observations of feral ducks and pheasants killed apparently by the agricultural sowing of DDT-treated rice.—David W. Johnston.

SABINE, W. S. 1955. The winter society of the Oregon Junco: the flock. Condor, **57**: 88–111.—Two winter flocks of *Junco oreganus* were color-marked so that social phenomena might be observed. Some of the important conclusions reached in this detailed investigation were: flocks are stable until spring dispersal, only relatively small flocks and individuals move from one feeding spot to another, more frequent visits are made to feeding spots on colder days, winter flocks may include both local and winter residents, transients probably attach themselves to already established flocks, and winter residents disappear abruptly at the onset of the migratory season.—David W. Johnston.

SCHULTZ, V. 1955. Status of the Wild Turkey in Tennessee. Migrant, **26**: 1–8.

SELANDER, R. K. 1955. Great Swallow-tailed Swift in Michoacan, Mexico. Condor, **57**: 123–125.—This is an extension of known range of over 500 miles for *Panyptila sancti-hieronymi*.

SELANDER, R. K., and M. A. DEL TORO. 1955. A new race of Booming Nighthawk from southern Mexico. Condor, **57**: 144–147.—*Chordeiles minor neotropicalis*; southern Mexico from Chiapas north to central Guerrero, Veracruz, and southern Tamaulipas.

SHELDON, W. G. 1955. Methods of trapping woodcocks on their breeding grounds. Journ. Wildl. Mgt., **19**: 109–115.—Spring-set butterfly-shaped nets were quite effective for catching males. Japanese mist nets were effective in summer.

SHELFORD, V. E., and R. E. YEATTER. 1955. Some suggested relations of Prairie Chicken abundance to physical factors, especially rainfall and solar radiation. Journ. Wildl. Mgt., **19**: 233–242.—Recommendations include measurement of visible light, ultraviolet light, moisture, temperature, etc. on study areas; pairing of factors in analyses of data; correlation of number of eggs produced per female with these factors.

SKUTCH, A. F. 1954–1955. The parental stratagems of birds. Ibis, **96**: 544–564; **97**: 118–142.—Some birds do not flush from the nest until an observer is practically upon it; others stealthily leave the nest while an observer is yet a long way off. Any middle ground between these two behavior patterns is strategically unsound. Many birds that flush only when pressed use also a distraction display or injury simulation; the evolutionary derivation of such behavior is discussed at length. Much detailed field observation is marshalled to support the author's theses.

It is understandable, but, I think, nonetheless unfortunate, that scientific papers today have often to be published in two, or more, parts, due to restrictions in length. But it is not right to put these fractions into two separate volumes of a journal, as has happened in the present, excellent paper by Dr. Skutch.—R. F. Johnston.

SKUTCH, A. F. 1955. How birds handle their population problem. Animal Kingdom, **58**: 72–77.

SKUTCH, A. F. 1955. The Hairy Woodpecker in Central America. Wilson Bull., **67**: 25–32.—The habitat and roosting and nesting habits of *Dendrocopos villosus* in Guatemala and Costa Rica are described.

SMITH, A. J. 1954. Lutino Willow Warbler. Scot. Nat., **66**: 126.—Lacks melanin pigment.

SMITH, D. A. 1955. Predation on mosquitoes by a Willow Ptarmigan chick. Ont. Field Biol., **9**: 21.

SMITH, D. A. 1955. Birds taken in a trap-line for small mammals. Ont. Field Biol., **9**: 22–23.—At Churchill, Manitoba.

SOUTHERN, H. N., R. VAUGHAN, and R. C. MUIR. 1954. The behaviour of young Tawny Owls after fledging. Bird Study, **1**: 101–110.

STEWART, I. F. 1954. Red-backed Shrike in Inverness-shire. Scot. Nat., **66**: 127.

STRESEMANN, E., and P. THOMSEN. 1954. J. F. Naumanns Briefwechsel Mit H. Lichtenstein 1818–1856. Acta Hist. Sci. Nat. Med., Copenhagen, **11**. 74 pp.—The correspondence, long believed to have been lost, between the celebrated Johann Friedrich Naumann and Lichtenstein, director of the Berlin Museum, gives an interesting picture of the development of ornithological knowledge in the first half of the 19th century. At that time there was still doubt about the validity of some well known European species and the study of molts and plumages was yet at the beginning. The letters are perhaps most valuable for the light they throw on the personalities not only of the two writers but also of many of their contemporaries, particularly C. L. Brehm.—Ernst Mayr.

STULTZ, A. 1955. Another Blue-footed Booby in southern California. Condor, **57**: 123.

SUMMERS-SMITH, D. 1955. Display of the House Sparrow *Passer domesticus*. Ibis, **97**: 296–305.—Pair-formation, courtship-feeding, billing, presentation of nest material, coition, pair ceremonies at the nest, attraction of nestlings from the nest, threat display, and aerial chasing are described.—R. F. Johnston.

SUTTON, G. M. 1955. Glossy Ibis in Oklahoma. Condor, **57**: 119–120.

TABER, W. 1952. Altitudinal Records. Bull. Me. Aud. Soc., **8**: 74–85.—Many

years' records of spp. encountered at various altitudes in mountainous areas. An annotated list.

TANNER, J. T., *et al.* 1954. Bird mortality during night migration October 1954. Migrant, **25**: 57–68.—Detailed analyses and a summary of instances of bird mortality especially at ceilometers in Tennessee.

TODD, W. E. C. 1955. Taxonomic comment on races of Leach Petrel of the Pacific Coast. Condor, **57**: 122.—Specimens of *Oceanodroma leucorhoa willetti* proved to be inseparable in color and measurements from *O. l. chapmani*.

TOMKINS, I. R. 1954. Life history notes on the American Oyster-catcher. Oriole, **19**: 37–45.

TORDOFF, H. B. 1954. Social organization and behavior in a flock of captive, nonbreeding Red Crossbills. Condor, **56**: 346–358.—A flock of 12 birds was caged and studied. Information relating to feeding, bathing, and social behavior is presented. Especial attention is devoted to peck-order of males and females and to the dominance of males over females. Triangles of dominance are also reported.—David W. Johnston.

TOWE, A. L. 1954. A study of figural equivalence in the pigeon. Journ. Comp. Physiol. Psych., **47**: 283–287.

TUCKER, H. M. 1955. Calliope Hummingbird entangled in grass barbs. Condor, **57**: 119.

VON BLOEKER, J. C., JR. 1955. Albino swallow in Sequoia National Park. Condor, **57**: 63.

VON BOETTICHER, H. 1955. Die Larmvogel, Turakos und Pisangfresser (Musophagidae). A. Ziemsen Verlag, Wittenberg, Die Neue Brehm-Bucherei, No. 147. 72 pp., 24 fig., 10 maps, 1 col. plate 3 DM.—A short popular description of the species of African touracos. Some thirty pages are devoted to a summary of their habits as recorded in the literature. All major kinds of touracos are illustrated.—Ernst Mayr.

WARNER, D. W., and B. E. HARRELL. 1953. Una nueva raza de *Dactylortyx thoracicus* de Quintana Roo, Mexico. Rev. Soc. Mex. Hist. Nat., **14**: 205–206.—*Dactylortyx thoracicus paynteri*, new subspecies.

WATSON, A. 1954. Bridled Guillemot counts in Norway. Bird Study, **1**: 169–173.

WATSON, A. 1954. Nesting of the Shag in Banffshire and Aberdeenshire. Scot. Nat., **66**: 122–123.

WATSON, A. 1954. Curlew nesting in cornfields. Scot. Nat., **66**: 125.

WATSON, D. 1955. Lesser White-fronted Geese in the Stewartry of Kirkcudbright. Scot. Nat., **66**: 186–188.

WEST, D. 1955. Pied Flycatcher in East Inverness. Scot Nat., **66**: 145.

WETMORE, A. 1955. The genus Lophodytes in the Pleistocene of Florida. Condor, **57**: 189.

WILLIAMSON, K. 1955. A synoptic study of the 1953 crossbill irruption. Scot. Nat., **66**: 155–169.

WINSTON, F. A. 1955. Color marking of waterfowl. Journ. Wildl. Mgt., **19**: 319.—To get information on movement, the Florida Game and Fresh Water Fish Commission (Tallahassee, Florida) is dyeing waterfowl, mostly Blue-winged Teal, each spring with red, green, and yellow. Reports have been received from as far as North Dakota.

WOLF, K. Some effects of fluctuating and falling water levels on waterfowl production. Journ. Wildl. Mgt., **19**: 13–23.—*Anas platyrhynchos*, *Aythya americana*, and *Fulica americana* were variously affected by rising and falling water on Idaho reservoirs.

WOLFSON, A. 1955. Origin of the North American Bird Fauna: critique and reinterpretation from the standpoint of continental drift. Amer. Midland Nat., **53**: 353–380.

WOOD, D. M. 1955. Nesting of Brewer's Blackbird at Sault Ste. Marie, Ontario. Ont. Field Biol., **9**: 23.

WOODFORD, J. 1955. Grackle's feeding behaviour. Ont. Field Biol., **9**: 25.

WOODFORD, J. 1955. The Bluebird Project—1954 report. Ont. Field Biol., **9**: 25.

YEAGER, L. E. 1955. Two woodpecker populations in relation to environmental change. Condor, **57**: 148–153.—On two widely separated and different study areas woodpecker populations were determined over a period of several years. In the Illinois area, flooded hardwoods died by the thousands; there was a subsequent increase in species and numbers of woodpeckers. In Colorado, millions of conifers died due to a mass bark-beetle outbreak; in this instance woodpeckers fluctuated in numbers.—David W. Johnston.

YOUNG, H. 1955. Breeding behavior and nesting of the Eastern Robin. Amer. Midland Nat., **53**: 329–352.

An intensive life history study of the European Swallow (*Hirundo rustica rustica*) is being undertaken, and information on all aspects of this bird's life throughout the year will be very welcome. Comparative material on all the species and subspecies of the genus *Hirundo* is to be included, and information on the Barn Swallow will be particularly appreciated. Full acknowledgments will be made on any material published.—Henry A. Bilby, 2, Sunnyside Cottages, High Street, Harlington, Hayes, Middx., England.

The *Handbook of/North American Birds/Outline for Collaborating Authors;/ Sample Pages*, a 59-page illustrated brochure, was printed May 23, 1955. On that date it was mailed to various persons and a few scientific libraries. A limited supply of copies remains. Persons needing this item should address their request to Dr. Ralph S. Palmer, New York State Museum, State Education Building, Albany 1, New York.

Most of the following errata were corrected in copies mailed: p. 2, 14th line from top, for 33 *read* 35; p. 5, last line, for 33 *read* 35; p. 13, lower right figure, transpose guide lines for Femoral *and* Crural; p. 25, 14th line from bottom, for grown *read* growth; p. 31, in lower box, for *Wilson* read *Wilsonia*; p. 43, 2nd line under Voice, for *neeiah* read *meeiah*; p. 49, 15th line from top, for Quachita *read* Ouachita; p. 51, 5th line from bottom, for indicates *read* indicate.

OBITUARIES

GEORGE FINLAY SIMMONS, a Life Member of the American Ornithologists' Union, died in Chicago, Illinois, July 20, 1955. He was born in Sherman, Texas, October 25, 1895. In 1910, at the age of fifteen, he became an Associate of the Union, and in 1923, a Member. After beginning the study of law in Houston, Texas (1913–14), he eventually specialized in zoology. The degree of B.A. (1921) and that of M.A. (1922) were received from the University of Texas. The University of Chicago granted him the degree of Ph.D. in 1934.

Among his early and varied activities were: stenographer, secretary, and law clerk (1913–14); feature writer for the Houston Post (1912–15); reporter on the Houston Chronicle (1916); secretary of police in Houston (1916–17); assistant editor and editor of the Longhorn Magazine (1919–22); assistant, and instructor in zoology, and assistant in comparative anatomy, University of Texas (1919–22); and chief deputy commissioner, Texas Game, Fish, and Oyster Commission (1923).

He was leader of the Cleveland Museum of Natural History Expedition to the South Atlantic (1923–26), and simultaneously captain of the three-masted exploring ship 'Blossom.' In a period of two and one-half years, and after a voyage of 20,000 miles, 13,000 specimens in natural history were collected. From 1926–29, he was Curator of Ornithology at the Cleveland Museum. In the period 1927–31, he lectured on the biological sciences at Western Reserve University, and also lectured under the Alber and affiliated bureaus. He taught at Montana State University from 1936–41, during part of which time he was President of this institution. In 1942, he became associated with the University of Chicago, and at the time of his death was Associate Professor of anatomy at Loyola University School of Medicine.

A long, illustrated article, 'Sinbads of Science' (National Geographic Magazine, 1927, 52: 1–75), was written by him, describing the voyage of the 'Blossom.' His formal ornithological writings were quite limited. Two short papers were printed in the Auk (1914; 1915) and one on bird migration at Houston in the Wilson Bulletin (1914). His book, 'Birds of the Austin Region' (1925), is a well-known reference work.—A. W. SCHORGER.

DR. T. S. PALMER, secretary of the A.O.U. from 1917 to 1937 and long an active member of the Committee on Biography, died on July 23, 1955, at the age of 87.

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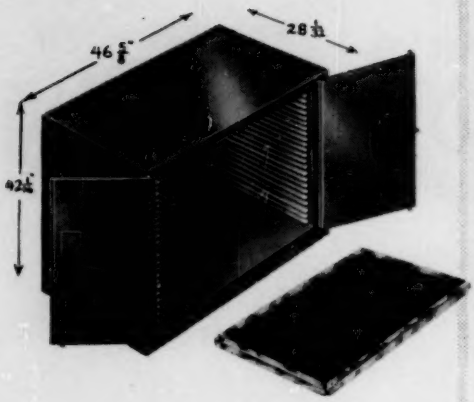

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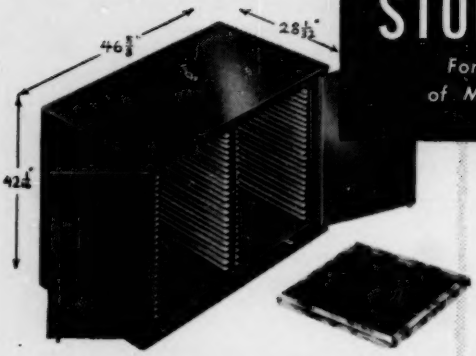

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